MADRAS FISHERIES DEPARTMENT.

THE EDIBLE MOLLUSCS OF THE MADRAS PRESIDENCY

BY

JAMES HORNELL, F.L.S.,

Government Marine Biologist, Madras.

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Report No. 1 (1917).

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THE EDIBLE MOLLUSCS OF THE MADRAS PRESIDENCY.

BY

JAMES HORNELL F.L.S.,
GOVERNMENT MARINE BIOLOGIST, MADRAS.

Except in Malabar the utilization of shellfish properly so-called has comparatively little economic importance at the present moment in the Madras Presidency. If Cephalopods, which are specialized and highly developed molluscs, be included, then Palk Bay may be added as a second locality, as several species of Octopus, Squid and Cuttlefish rise there to a position of considerable value in the economy of the lives of our fisherfolk. Except in these two localities the molluscan resources of our seas are largely neglected and undeveloped. Apart from the poorer classes of coast dwellers, shellfish as an article of food is generally despised, and except in the instance of oysters in Madras City, of mussels in Malabar, and squid in Ramnad district, none is ever seen exposed for sale in South Indian fish markets. When one remembers the important position occupied by various species of shellfish in the littoral fishing industries of other countries—Britain, France, the United States, and Japan are instances—this fact is much to be regretted, and it behoves the Fisheries Department to do everything possible to remove prejudice against the inclusion of shellfish in the general dietary of our towns and to increase the quantity and quality of those kinds which are both suitable from the food standpoint as well as susceptible by cultivation of extended increase in the amount available for distribution. It may also be found necessary to supplement our indigenous supplies by the introduction of larger and more prolific species and varieties from other countries; the discovery and introduction of such improved kinds should be kept steadily in view in all attempts to increase and improve our supplies of shellfish.

In this connexion it is notable that some shellfish highly valued in other parts of the world and occurring there in great abundance, are scarce and usually of small size in India. Four of the most

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notable are the scallops or pectens, the ear-shell *(Haliotis)*, the true cockle *(Cardium)* and the limpet *(Patella)*. Examples of all these occur on our Indian coasts but all are extremely scarce and in the case of the very valuable Haliotis, the size seldom exceeds 1½ inch in length, as compared with the British, Japanese and Californian species which vary from 4 to 6 inches in length. Several species of Indian Cardium are larger than the British forms, but they are seldom found alive, though dead valves are not uncommon on Coromandel beaches.

The need to protect the sources of supply from sewage contamination must also receive careful attention; many shellfish from their habits are liable to ingest bacteria from the water flowing over the beds, and whenever this be heavily charged with sewage, certain kinds, oysters in particular, which are often eaten either raw or lightly cooked, may transmit the infection and cause enteric fever and possibly other forms of bacterial disease. This point will receive further attention when treating of the edible oyster.

The following list and notes are not to be regarded as complete and exhaustive; lack of adequate skilled assistance has limited my tours largely to the southern section of the Presidency and this has prevented me from obtaining intimate acquaintance with many important fishing localities on the Madras seaboard, particularly with those northward of Pulicat Lake. To facilitate the identification of the forms mentioned below, text-figures of the more important are given. These are all original and drawn from life. For the care taken in their delineation, much commendation is due to Mr. M. Ramaswami Nayudu, B.A., my Shellfish Sub-Assistant, who is responsible for the whole series.

CATALOGUE OF MADRAS EDIBLE MOLLUSCS.

A.—Species in common use.

PELECYPODA OR LAMELLIBRANCHIATA.

Species.	English.	Tamil.
Mytilus smaragdinus	Green mussel ...	Kallikai; Pachchai āli.
Mytilus sp.	Brown mussel ...	Kallikai.
Arca granosa	Ark-shell	Vari matti.
Ostrea virginiana	Backwater edible oyster.	Āli; Pātti.
Ostrea cucullata	Rock oyster ...	Āli; Pātti.

Pelecypoda or Lamellibranchiata—*cont.*

Species.	English.	Tamil.
Meretrix casta	Backwater clams...	Matti.
Meretrix casta ovum	Backwater clams...	Matti.
Meretrix meretrix	Backwater clams...	Panjamatti.
Velorita cochinensis	Backwater clams...	...
Donax cuneata	...	Mural, and Vāzhi matti.
Circe gibba	Cockle clam ...	Vari matti.
Donax scortum	...	...
Mactra corbiculoides	...	Sevala matti.
Mesodesma glabratum	...	Kakkamatti.
Tapes ceylonensis	...	Vazhukkumatti.
Lamellidens marginalis	Fresh-water mussel.	...
	Gastropoda.	
Turbinella pyrum	Chank	Sangu.
Pterocera lambis...	Five-fingered chank.	Aiviral sangu.
Turbo margaritaceus	Turban shell ...	Nathai.
Oliva gibbosa	Olive	Kovanji and Sangu.
Purpura rudolphi	Rock whelk ...	Par attai.
Conus spp.	Cone	Semman utti.
Strombus canarium	...	Viranjan.
Patella spp.	Limpets	Unai.
Ampullaria sp.	Fresh-water snails.	Nathai.
Vivipara sp.	Fresh-water snails.	Umachchi.
	Cephalopoda.	
Loligo spp.	Squid	Eekki kanavai. Kundal ,,
Sepia spp.	Cuttlefish ...	Ottu ,,
Octopus sp.	Small devilfish ...	Pey ,, Sa ,, Sangu ,,
Do. sp.	Large ,, ...	Kundal ,,

B.—Species not utilized at present as food.

Margaritifera vulgaris	Pearl oyster ...	Mutthu chippi.
Modiola spp.	Weaving mussel ...	...
Pinna sp.	...	Akku.

B.—Species not utilized at present as food—cont.

Species.	English.	Tamil.
Barbatia barbata	Hairy ark-shell ...	...
Parallelopipedum tortum ...	Twisted ark-shell.	...
Solen sp.	Razor-shell ...	Pul akku.
Potamides (Telescopium) fuscum.	Horn-shell ...	...
Potamides (Pyrazus) palustris ...	Do. ...	...
Melongena vespertilio	Knobbed whelk ...	...
Helix spp.	Land snails ...	...
Ariophanta spp.		

MUSSELS (MYTILIDÆ).

Tamil—*Kallikai* (கள்ளிக்காய்) in the south; *Pachchai āli* (பச்சை ஆளி) at Pulicat.

Malayalam—*Kaduka* and *Kadalkai* in South Malabar; *Kallumakai* in North Malabar; *Nilakākka* in Cochin.

Kanarese—*Pacile.*

Tulu (North Kanara)—*Ajeer.*

Two species only of true Mussels (Mytilidæ) grow to a considerable size in the waters of this Presidency. One of these is the very handsome Green Mussel (*Mytilus smaragdinus* Chem.), readily recognized because of the handsome green coloration of the horny membrane or periostracum investing the exterior surface of its valves; the other is an even larger species, less elegant in contour, coated with a coarse brown periostracum that looks commonplace when contrasted with the vivid tint of the green. The former species is distributed widely upon the Madras coasts, extending as it does almost continuously from South Kanara on the west coast to the borders of Orissa on the east. The brown form, on the other hand, is confined, so far as I am aware, to the extreme south of Travancore and of the Tinnevelly district.

No representatives of the closely related genus *Modiola* are eaten, although several species are found, particularly in Palk Bay, where the sea-bottom is frequently carpeted over hundreds of acres with vast multitudes of *Modiola barbata*, *M. japonica*, and allied forms. These seldom grow more than an inch in length and live generally at a depth of three to five fathoms, hence their non-utilization as food. Could they be cheaply collected in quantity, they would form both an excellent food and, when dried and pulverized, a first-class manure.

Throughout South Malabar the green mussel is usually termed *Kaduka* which appears to be a corruption of *Kadalkai* ("sea-fruit") by which name it is known amongst better educated people; in Cochin this same shellfish is known as *Nilakākka*, the "long kākka," in contradistinction to the ordinary Kakka which is the common backwater clam (*Meretrix casta ovum*).

Mytilus smaragdinus, although so widely distributed, is found in large quantity only on the west coast from South Kanara to the northern part of Travancore. Within these boundaries, wherever rocks are found inside of the three-fathom line, the green mussel

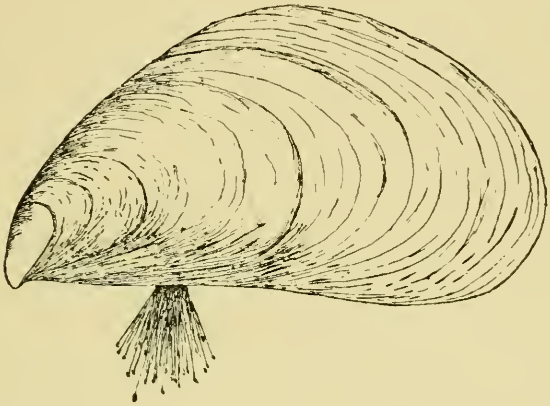

FIG. I.—THE GREEN MUSSEL. $\times\frac{3}{4}$.

usually finds conditions favourable and covers all exposed rocky surfaces and the walls of all crannies with its closely set multitudes. Wherever it is found, it is accompanied by edible oysters—chiefly *Ostrea virginiana*; we can clearly distinguish an *O. virginiana—M. smaragdinus* formation in such situations on both the east and west coasts. The rocky coast of South Kanara from Gangoli to Kāp, and that stretch of the Malabar coast from Eli Mala to Kadalundi are the two localities where conditions are most favourable for its growth; these localities produce the great bulk of the mussels consumed in these two districts. The south section of Malabar is too sandy and rockless to give foothold and few mussels are fished there.

The collection of mussels is a minor marine industry of some importance at several places, especially in the neighbourhood of Cannanore, Tellicherry, Mahē and Calicut, and also in Travancore.

The flesh is highly esteemed and is eaten by Muhammadans and Christians and by all Hindu castes inferior to the Nayars; in Malabar I understand however that even the last named consider mussels as a delicacy, although those of Travancore will not partake of them. Kitchen-middens composed largely of these shells, are often to be seen near huts as the train passes along the coast line between Calicut and Cannanore.

As the higher range of these mussels extends just above the low water level of spring tides, the greater quantity is got by collection from rocks exposed or awash at spring tides; a considerable number is however obtained from deeper water by divers. Both at Cannanore and at Tellicherry there are a few Mappillas who prosecute this industry for a few months in the year. The diver carries with him a coir bag and a bamboo stick sharpened at each end. With the latter he separates the mussels from the rocks and then brings them to the surface in the bag. They are fished only during the dry months from December to May by which time they have attained edible dimensions. During the south-west monsoon it is impossible to gather any owing to the violence of the sea and for a few months thereafter they are too small in size to be worth taking.

Cannanore, Tellicherry and Mahē are the only towns in Malabar where mussels are exposed for sale in the public markets. About half a dozen basketsful may be sold per day during the season. The demand is particularly active when fish is scarce and dear. In Calicut, Beypore, Badagara and some other large towns they are occasionally hawked through the streets. In other places there is no regular trade; the fisherfolk and other coast people living in the neighbourhood of mussel rocks, gather supplies at low tide for their own use and sometimes sell any surplus they have. A basketful weighing from 40 to 50 lb. fetches from 8 to 12 annas. The retail price when fish is scarce and mussels are in good demand in consequence, runs to about 30 to 40 for one anna.

Methods of Cooking.—In Malabar cuisine mussels are usually either made into curries or else are fried. In both cases the shells are first boiled just long enough to cause the valves to open, when the flesh is extracted and washed, and either cooked with curry stuff or fried in coconut oil after rolling in a curry batter, called *massala* paste.

Among the Mappillas a much more refined method prevails. After removing the flesh from the shells, each body is stuffed with

rice dough and steamed in a most ingenious and effective manner; a cooking vessel is half filled with water, a cloth is tied over the mouth, the stuffed mussels are laid on the cloth, and then another earthen vessel is inverted over the mouth of the first and the whole placed over a fire till it be judged the steaming is complete. Of the three methods described this last appears to be the most satisfactory; the frying method is probably the worst for people with poor digestion though it is doubtless the most tasty. Mussels are often furnished in coast toddy shops to customers who find them a good relish.

There is some question as to whether the demand for mussels on the Malabar coast is sufficiently great as to outstrip supply; a satisfactory method of cultivation whereby the supply could be largely increased and cheapened might be of much value to the coastal population. The exposed nature of the coast during the south-west monsoon would however render such an undertaking exceedingly difficult except at a prohibitive cost. Demand would probably be greater if the methods employed to cook them were more appropriate. Some of those employed, notably frying in oil, are likely to make them indigestible.

When the subject of framing regulations for the protection of immature fish throughout this Presidency becomes ripe for treatment, the question of the desirability of imposing a minimum size limit for mussels should also be included, as there is evidence that in some localities collection is occasionally so intensive as to reduce the average marketed size to objectionably small dimensions.

On the East Coast, the green mussel is comparatively rare; nowhere is it found in thickly stocked beds as in Malabar and Kanara. Yet almost everywhere along the coast occasional stragglers are found and in several estuarine backwaters where beds of the edible oyster (*O. virginiana*) occur, they become comparatively numerous. In the Government Oyster Farm in Pulicat Lake, about a couple of score can usually be collected in a day by one man from among the oyster clumps. At Pulicat where they are known as *Pachchai āli* or green oysters, they are occasionally utilized by Pariahs who eat the flesh cooked with curry-stuffs.

In the Sonapur backwater in Ganjām district this mussel is fairly abundant, considerably more so than at Pulicat. As in the latter locality, its habitat is on the oyster patches in the deeper parts of the backwater. Particularly numerous is it in the deep main

channel near the Fish-curing Yard at Revu Sonapur village. Here occurs a deposit of large oysters living in great clustered clumps; in the angles and crevices of these masses the green mussels find suitable lodgment. They vary from single individuals to groups of three or four; seldom do they exceed this number; they never form a massive deposit nor do they ever cover their habitat with a living carpet as they do in Malabar. At Sonapur they have economic value but not as food. Owing to certain characteristics of this backwater these mussels are largely infected with the larvæ of parasitic worms, and, induced by the irritation thus produced, pearl formation is frequent. For many years past this peculiarity of the Sonapur mussels has persisted and those of the local fishermen who can dive, devote considerable attention to the mussel fishery at times when the water in the channel is low. The pearls found are moderate in size and of poor colour, usually pinkish, but as the mussels yield them fairly abundantly, the beds are well exploited. I saw a few of these mussel pearls when at Sonapur in May 1915, and I was informed that the price paid by the local dealers to the fishermen ranges between Rs. 5 and Rs. 10 per tola.

From the observations made (which I hope to amplify shortly) these pearls are found to have a related origin to that of the pearls sometimes produced in quantity by the common mussel (*Mytilus edulis* L.) of France and England. The Sonapur backwater is the haunt of myriads of seagulls and waterfowl and it is from the adult parasites contained in the alimentary canals of these birds that the flat-worm larvæ found in the adult mussels are derived. Under certain circumstances occasional larvæ induce the formation of pearls in the mantle of the mussel, the dead body of the parasite persisting as the nucleus of the pearl. The life-history of the Sonapur pearl-inducing parasite has yet to be worked out.

THE BROWN MUSSEL (MYTILUS sp.).

Tamil—*Kallikai* in South Travancore.

This mussel is the largest and stoutest species found in South India, attaining commonly a length of 4 inches. It is distinctly larger than the green mussel, but unlike the latter its distribution is limited to a comparatively short length of coast in South Travancore, where it displaces the green species. The coast there is exposed to exceptionally heavy seas during the monsoon, but in spite of this it thrives in great abundance on rocks from low tide level to a depth of about 2½ or 3 fathoms. Annually large quantities

are taken from the rocks by divers. They form an important food item among fishermen and coast Muhammadans.

THE RIBBED ARK-SHELL (ARCA GRANOSA, Linn.).

Tamil—*Vari matti* (வரிமட்டி).

This fine shell is nowhere common. In appearance it looks like a very rugose cockle; the flesh is distinctively coloured red, due to the blood being of this hue, an exceptional condition among molluscs where the blood is generally colourless or tinted pale bluish green.

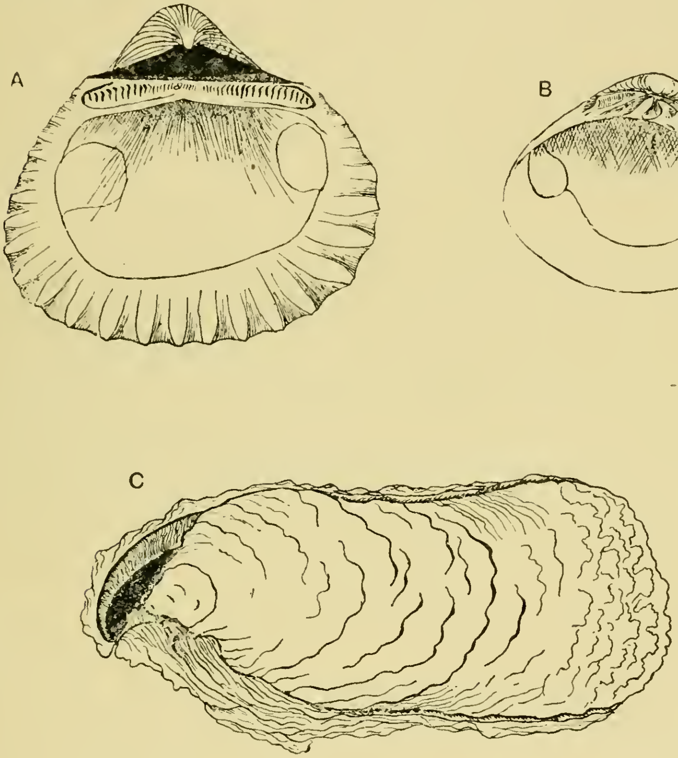

FIG. 2.—A. RIBBED ARK-SHELL. × 1.
B. COMMON MATTI OR CLAM. × $\frac{3}{4}$.
C. BACKWATER OYSTER (*O virginiana*) × $\frac{1}{2}$.

It occurs sparingly distributed in sandy backwaters on the East Coast. In Pulicat Lake it is not uncommon.

The flesh is tough, but because, presumably, of its red colour, some shore dwellers have the idea that it has specially nutritious and strengthening qualities; on this account it is often given to women during pregnancy.

In size it seldom exceeds 53 mm. in length by a thickness of 42 mm.

It is noteworthy that this species is reported to be the subject of very profitable cultivation in Japan, where from one culture area of 830 acres between 75,000 and 100,000 bushels are obtained annually. The methods employed are simple; they depend for success upon the fact that the fry of Arca, after quitting the free-swimming stage, tend to settle in definite areas in great quantities. Once these are discovered the young ark-shells can be raked up in thousands—usually when they are about 3 mm. long—and transplanted to culture grounds where they are strewn and left to burrow into the bottom. As they grow larger, from time to time they are redistributed in order that overcrowding and food shortage may be avoided. They are said to attain a marketable size in their third year. The bulk of the produce is exported to China.

OYSTERS (OSTREIDÆ).

Tamil—*Ali* (ஆளி), Pulicat; *Pātti* (பாட்டி), Tuticorin.

Malayalam—*Muringa* in Travancore and Cochin; *Muru* in Calicut.

The edible oysters of Madras Presidency are two in number, the backwater or mud oyster (*Ostrea virginiana* Gmelin) and the rock-oyster (*O. cucullata* Born). The former is the one specially valued and the one which lends itself to cultivation; the second, whilst good flavoured, is rather tougher as well as smaller than the other and is seldom eaten except at one or two places on the Kanarese coast where it is specially abundant.

The Madras backwater oyster is extremely variable in form and has passed under many names. Among the more recent under which it has been described is that of *O. madrasensis* by Preston [1]. It has however no outstanding differences from the common American species and I agree with Vredenburg in believing it to be in nowise separable from this widely distributed form. It is appropriate to say here that very little is known at present concerning the number and relationship of the different Ostreids of Indian waters, and their nomenclature is in a state of considerable confusion. A review of the species is urgently needed. To this end I am accumulating material and I shall be very grateful for

[1] Preston, H. B.—Report on a collection of Mollusca from the Cochin and Ennur backwaters. *Records of the Indian Museum*, Vol. XII, part 1, Calcutta, 1916.

any representative specimens from different parts of India, Ceylon, Burma, and the Persian Gulf, that any one in a position to help, may be kind enough to send. No less than half a dozen shells should be sent from each locality and these should comprise as great a variety of form as possible. The typical or most common form assumed in each locality, should be distinctively indicated, wherever possible.

This species of oyster under notice is very hardy and can sustain considerable fluctuations in the salinity of the water it lives in. Hence it thrives in nearly every estuary and backwater on both the coasts of the Presidency ; only exceptionally, as on some rocks situated near estuaries on the Malabar coast, does it form considerable deposits in the open sea, although odd individuals are often met with wherever rocks occur upon the littoral. Young oysters of this species are also often met with on shells in water up to 8 fathoms in depth, but these do not thrive and seldom survive to maturity.

Backwater oysters have considerable value to the poorer population living in the neighbourhood; the chief centres on the west coast are the backwaters at Tellicherry and Beypore in Malabar, Cochin and Azhikode in Cochin State and Vembanad backwater in Travancore. On the east coast the backwaters at Cuddalore, Covelong, Ennur and Pulicat are famed for the abundance of their oyster beds, while further north there are extensive beds in the deltas of the Kistna and Gōdāvari and in the backwaters of Vizagapatam and Ganjām. The oyster beds of Sonapur backwater in Ganjām are the most extensive of these latter.

Unfortunately the better classes of Indians do not appreciate oysters and none will make use of this excellent food-supply. Among Hindus, only the lower classes of shore dwellers eat oysters, together with some Muhammadans and Indian Christians. The only better class trade in oysters is that supplying the requirements of Europeans and Anglo-Indians in a few of the larger coast towns, as Madras, Calicut, Cochin and Mangalore. Many of the sources of supply are however under grave suspicion of possible sewage contamination. Because of this and in order to provide a supply of good quality oysters free from any danger of being disease carriers, Government in 1910 permitted the Fisheries Department to form a model oyster park in Pulicat Lake where oysters are cultivated under hygienic conditions and thence distributed throughout the length and breadth of the Presidency.

The most extensive oyster beds in South India are those in Cochin harbour and in Vembanad backwater in Travancore. In both localities oysters are exceedingly numerous, the flesh finding a ready sale among the lower classes. In the Vembanad villages, the flesh, called *Moringa irachi*, is said to be regularly exposed for sale in the fish market. In Cochin it is not seen in the markets, being hawked about the streets in small-mouthed chatties. The beds in Cochin harbour chiefly lie within what are claimed to be Cochin State limits and the right to fish oysters is let annually by the Darbar for a small sum, seldom if ever exceeding Rs. 100 per annum. In practice, the lessee sublets the right to individual divers who pay him a small sum for each day's fishing. The divers are usually Roman Catholic Christians. As the water over the beds varies from one to three fathoms the men require to dive for the oysters; when the current is strong the assistance of a pole thrust into the bottom is resorted to, the diver using this to prevent himself being carried away. As the oyster clumps are collected they are piled into a small attendant dug-out canoe and as soon as this is full, a matter of some three hours' work, the spoil is taken to the shore where women purchase it at the rate of from 10 annas to 1 rupee per lot—a quantity usually averaging about 800, or a rate of 1½ to 2 annas per hundred. The buyers proceed to open them, putting the flesh into an earthen pot containing a little water. This flesh they hawk through the town at from 2 to 4 annas the hundred. Surplus oysters are sometimes kept alive in the canals till wanted—an extremely insanitary proceeding.

Oyster flesh is never eaten uncooked by Indians; the common method of preparation on this coast is to fry the flesh in ghee after flavouring with salt and condiments. The trade is of considerable volume in Cochin in spite of the fact that many of the largest beds are subject to sewage contamination. The fact that the flesh is never eaten except after cooking appears to be an effective safeguard. It is noteworthy that the discarded oyster shells, in the absence of any local rock, are put to extensive use in reclaiming swamp land and as foundations for buildings.

In the Beypore, Elattur and Tellicherry backwaters, oysters abound wherever rocks occur and good quantities are taken annually by the womenfolk of the local Hindu fishing communities, who collect oyster flesh at low tide, breaking open the shells with short iron knives as they occur *in situ* and transferring the flesh to small chatties which they take with them.

On the east coast, in the backwaters in the neighbourhood of Madras, a certain amount of oyster flesh is collected and eaten by the local Pariah population. Sometimes Muhammadans will have some, but this appears to be done in imitation of the European custom. In these places the bulk of the oysters consumed, as already mentioned, is by the Europeans and Anglo-Indians of the large towns.

Further north, in Ganjām district, certain sections of the fishing population make a limited use of the local oysters, particularly those in the Sonapur backwater where the Bairavi women are accustomed to visit the beds at low water, break open the shells and carry away the flesh in chatties to use in their own curries.

Seasons and spawning.—The season when oysters are in marketable condition depends upon the time of spawning and this in turn is controlled by rainfall and sunshine. Heavy rains causing flood water to enter backwaters in such amount as to greatly lower the salinity of the water over the beds, invariably entail widespread and immediate emission of the reproductive products in all oysters where the gonads are well filled. Hence as the rainy season differs on the two main coasts of India, there is a corresponding divergence in the spawning maxima and in the marketable season in these two localities.

On the Malabar coast the chief spawning maximum occurs about midsummer or even earlier, at the onset of the south-west monsoon and the oysters are not again in condition till October or November. From this time onwards they improve in quality till about the end of March; thenceforward till the final and complete spatting at the end of May or early in June, there is a good deal of irregular spatting induced by the hot weather then prevailing, emphasized by the exposure and semi-drying of many of the oyster-covered rocks during low water of the major spring tides. Between March and June a considerable percentage of spent oysters are always found in any number examined; the gonads of those that spawned early in March will be partly full again when the floods arrive in June and these, after enduring the lowered salinity of the water for a while, will at last emit their spawn though perhaps only half mature. Long continued floods cause very extensive mortality on the beds, and few survive except the small number living on the bottom of deep channels. In these places saline conditions appear to last much longer than on the surface,

the lighter gravity of flood water causing it to pass over the deeps without clearing out completely the saline water which was there before the onset of the floods. Spawning in the case of these few surviving oysters appears to be deferred till about the end of August when the floods have partly subsided and tidal conditions are re-established. Much variation exists however in this cycle of events, for under normal conditions the common Indian oyster is a most irregular spawner; except when the floods are on, some individuals with ripe gonads can always be found; hence there is no definite and universal spawning season as the case of the English oyster (*O. edulis*). Mortality amongst oysters during the rains is confined to those living well within the backwaters; those close to the mouth suffer less and many survive, except in exceptional years when the floods are very long continued. Much, too, depends on the physical conformation of the backwater. In such a one as that at Cochin, the oysters on the beds in the harbour usually survive, the considerable (relative) depth of water over the beds constituting a protection.

On the Coromandel coast, as the floods take place generally from the end of August until November, the season runs from December to the middle of August, with a partial break about April when a large proportion of oysters spawn. August and September constitute the main spawning maximum, induced in part by the hot weather prevailing then and in part by the lowering of salinity due to flood water. In a wet season the latter is the main factor; in exceptionally dry ones or when the rains are long deferred, the former is the effective factor. A second maximal spawning takes place in March and April, and between this time and August, spawning individuals can always be found.

The reproductive habits of this oyster are similar to those of the Indian Pearl-oyster (*Margaritifera vulgaris*) and closely akin to those of the Portuguese oyster (*Ostrea angulata*). In all these species the sexes are separate; the ripe ova and spermatozoa are poured forth freely into the surrounding water when a sufficient stimulus is experienced. Fertilization takes place in the water outside the parents' bodies, trochophore and veliger forms being in turn assumed during the growth of the fertilized ova. The free-swimming stages last for several days and in this time they may be carried by currents for considerable distances, thus ensuring wide dispersion throughout the neighbouring coasts. The free-swimming spat when ready to attach is easily obtained in any suitable estuary or back-

water by the employment of spat collectors ; experience shows that ordinary country roofing tiles, arranged in low piles of several rows, are the most suitable form to use. During our first experiments at Pulicat, we arranged these collectors with a view to catch the spat produced during the September spawning season ; experience shows that it is preferable to aim at obtaining the necessary spat during spring (first half of April), as the parent oysters are in much better health then ; the results obtained are altogether better, for operations can then be carried out with greater facility, the water level in the parks being lower than it is in September.

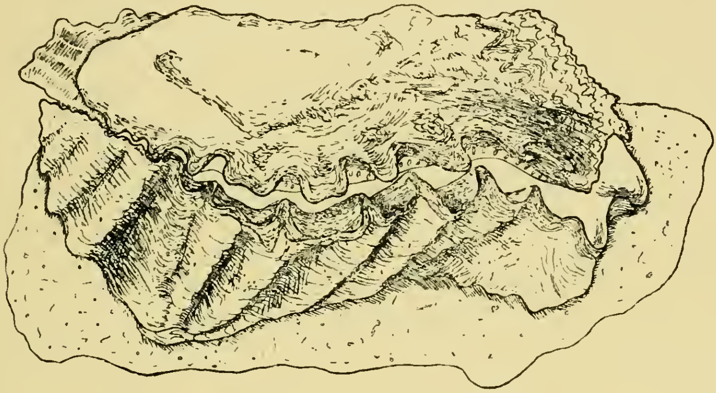

FIG. 3.—THE ROCK OYSTER (*Ostrea cucullata*). Natural size.

THE ROCK OYSTER—OSTREA CUCULLATA (Born).

This oyster differs greatly from the backwater oyster. Its main distinguishing characters are as follows :—

Outline roughly oval ; the left valve extensively attached, deep and cup-shaped, with a sacciform extension into the hollow beak region of the hinge, which is moderately elongate in freely-grown individuals ; the edges of this valve have a distinct tendency to grow upwards. Externally the left valve is folded into deep ridges passing radially outwards from the hinge and ending in a strongly dentate edge which tightly interlocks with the edge of the upper or right valve. The latter is flattened and opercular in form. The muscle scar of both valves is usually dark purplish-black in tint, rarely white. Very characteristic is a row of closely set elongated denticulations seen a short distance inwards from the margin on the inner surface of the upper valve ; these fit into a

corresponding series of furrows in the lower valve. Externally the shell is tinted an opaque pinkish purple. Internally it is white, margined with purple or black. The size is generally smaller than that of the ordinary backwater or mud-oyster and seldom exceeds three inches in length.

The habitat of rock oysters is a narrow band between tide marks; during ordinary spring tides, these oysters are entirely uncovered at low tide. They are purely a marine species, never forming beds in backwaters or estuaries, though an occasional dwarfed individual is occasionally to be seen among backwater oysters.

Under favourable conditions they form densely crowded colonies upon rocks between tide marks; the finest example of such beds which I know, is on the rocky shores of St. Mary's Isles, off Malpe, in South Kanara. They are of excellent flavour, but on account of their small size, both natural and often further reduced by over-crowding, as well as the difficulty experienced in opening them by reason of their interlocking edges, they are not of any economic importance.

BACKWATER CLAMS.

At least four estuarine clams of value as food are found in the Presidency, namely :—

Meretrix meretrix, *M. casta*, *M. casta* var. *ovum*, and *Velorita cochinensis*. (See Fig. 4).

The first of these is comparatively scarce, and the third, which is of chief importance in Malabar, is not found on the east coast where *M. casta* takes its place as the most abundant of backwater clams.

THE SMALL CLAMS (MERETRIX CASTA AND M. CASTA var. OVUM).

Tamil—*Matti* (மட்டி).

Malayalam—*Erunthu* at Calicut ; *Kākka* at Cochin.

Everywhere along the coast from South Kanara in the west round to Ganjām in the east, with the exception of the Gulf of Mannar and Palk Bay, either one or other of these little clams is found abundantly in muddy sand in estuaries and connected back-waters wherever the water remains saline throughout the greater part of the year. Suitable conditions prevail over more extensive areas on the west coast, and it is there, *par excellence*, that these clams attain their greatest importance.

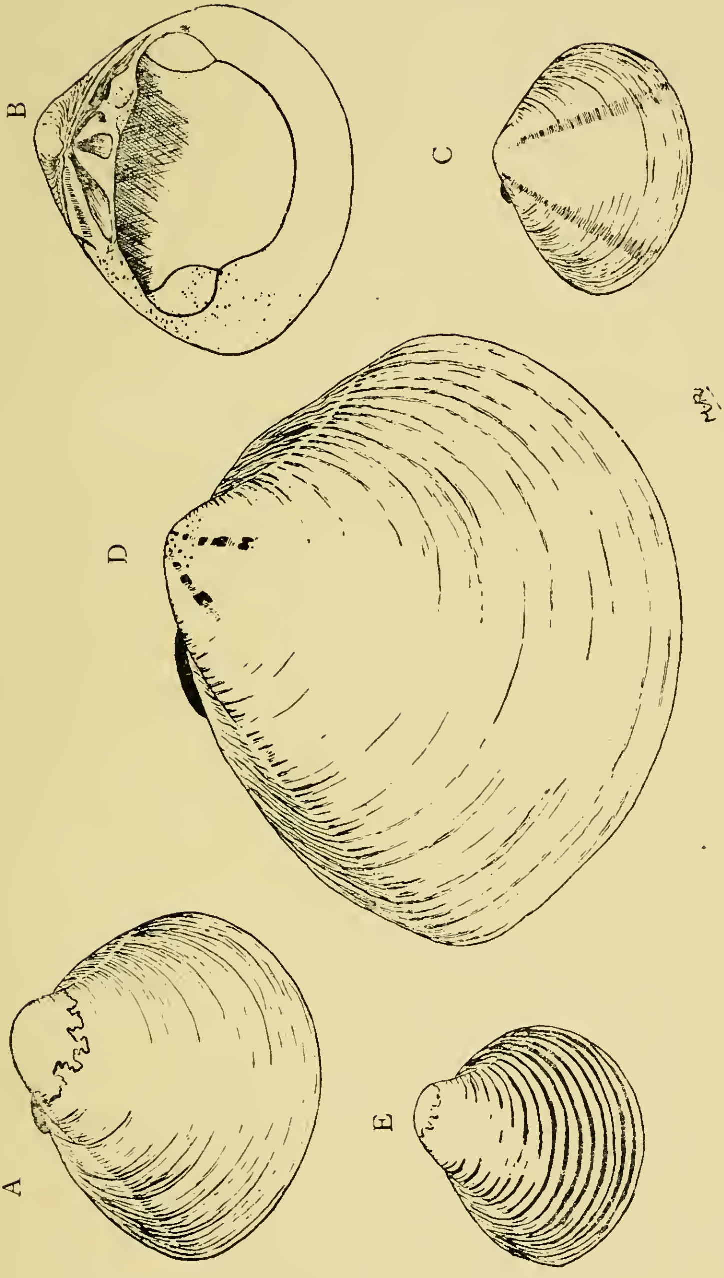

Fig. 4.—Backwater Clams.

A & B.—*Meretrix casta*, outer and inner view of a valve; C.—*Meretrix casta* var. *ovum*; D.—*Meretrix meretrix*; E.—*Velorita cochinensis*. All natural size except E, which is × $\frac{2}{3}$.

Meretrix casta var. *ovum* (Hanley). The valves of this subspecies or variety are described as usually ovate to oblong, subequilateral, covered with a thin greyish-yellow periostracum and either with or without two narrow brown bands radiating from the hinge region ; the umbones centrally disposed and often corroded ; the posterior margin stained greenish grey ; length seldom exceeding 40 mm.

Such a description serves well for the species found in great abundance in west coast backwaters, although when overfished as in the Beypore River, the average size becomes considerably reduced, as few individuals have an opportunity to reach maturity. The two dark rays thought faint and easily overlooked, are very characteristic of this variety ; only occasionally in the adult can these rays be traced back to the umbo ; they are usually best marked towards the ventral margin where they often terminate in two small reddish brown colour patches on the extreme edge. The periostracum is well developed and persistent ; it varies from a distinct pale cream to a rufous yellow or even brown, the darker tints being largely of stain origin. The posterior margin usually appears of a greenish tinge in shells from Beypore River until the periostracum be removed, when it is revealed as actually greyish blue in tint.

This clam is probably the most important food mollusc of the Presidency. Its flesh is of good flavour, tender and nutritious. To the poorer classes of shore dwellers, wherever it is obtainable in quantity, it often takes the place of fish in their curries when this is dear or scarce and is esteemed both for its cheapness and tastiness. On the Malabar coast these clams are largely collected by low caste people who hawk canoe-loads along the backwaters and canals. The usual retail rate varies from one to two pies per seer, indeed a pie's worth is considered in Malabar sufficient to make a curry for a whole household. The Malabar clam fishers usually use very small dugout canoes, which are anchored when the fishing ground is reached. Men, women, and lads all engage in the fishing ; the feet are used to locate and dislodge the clams when these occur in shallow water. In deep channels diving has to be resorted to.

Amongst the common sights in Malabar are heaps of discarded *erunthu* shells forming miniature kitchen middens in the neighbourhood of many huts ; these are sold eventually to lime-burners, as the shell of this clam, being exceptionally massive, is valued

highly as a source of high-class lime, particularly suitable for white-washing purposes.

On the east coast, the place of *M. casta ovum* is taken by the type form of *Meretrix casta* (Gmelin), a rather larger and stouter shell of the same habits, known generally as *matti* in Tamil districts. Its valves are thick and massive, the exterior covered with a strongly adherent brownish yellow periostracum, dull in appearance, that varies much in tint even in one locality. A dark purplish black band margins the posterior edges of the shell to a depth of about a quarter of an inch, extending from the hinge to the posterior angle of the shell ; unlike the yellowish colouring of the rest of the shell, this purple pigment permeates the substance of the valves and shows equally upon both the inner and the outer surface. The shell exhibits none of the radial banding of the sub-species, nor any of the diverse colour schemes of spots and chevrons so often found on the umbones of *M. meretrix*.

Although often very abundant it is generally less common than the corresponding species on the west coast and is held in less esteem by the people. It is however eagerly sought for wherever it abounds. At Pulicat, for instance, as many as 30 women may often be seen collecting this shellfish in the shallows opposite the town. Unlike the custom in Malabar, men here seldom engage in this work ; Pariah women and girls alone carry it on. They work for preference during low tide when the depth of water is reduced over the beds. From time to time as they gather the clams, they pile them in heaps on an adjacent sandbank. When they judge it time to drop fishing, they adjourn to the sandbank, and there proceed to smash the clams one by one by striking them against a heavy stone. As each is broken open they deftly extract the meat with a push of the thumb, dropping it into a small earthen pot containing a little water. In this way in a short time each woman has emptied the whole of her catch, amounting to several hundreds. The broken shells are left behind for the lessee who has bought the right to the shells for lime-making, and who permits these women to collect them on this condition.

Women's wages at Pulicat average 2½ to 3 annas per day and the value of the catch of clams made in a day by one woman working hard, is usually valued at this amount. The bulk of the clam meat obtained is however generally used to supply the needs of the woman's own family; if any surplus is left, it is often

exchanged for paddy, bulk for bulk, I am informed. At times when specially large quantities are obtainable, the surplus flesh is sundried to serve as stock for use during the rainy season when the collection of clams is interrupted owing to increase in the depth of water over the beds.

Pariahs and Pallans and some of the Muhammadans and Christians of coast hamlets are the only people who eat these clams in Tamil districts.

On the east coast, spawning appears to take place twice in each year, the first during April and May, the second about September. The busiest fishing season at Pulicat and the neighbourhood is the hot dry season from June to August when the level of the backwaters and canals becomes much reduced, facilitating greatly the work of collection. At this season the condition of these clams is at its best, the bodies fat and swollen with reproductive products.

THE GREAT CLAM—MERETRIX MERETRIX (Linn.).

Tamil—*Panjamatti* (பஞ்சமட்டி), Tuticorin.

This is a nearly related species to the common matti *(M. casta)*. It is distinguished by its greater size and by the smoothness and delicacy of the periostracum covering the valves. Its average size when adult ranges between 74 × 60 mm. and 75·× 62·5 mm. with a weight (empty) of about 3½ ounces. So long as the periostracum is intact the valves have a beautifully polished appearance due to the smoothness of this membrane, which is thin, delicate, and either grey or a pale straw colour in tint. Along the postero-dorsal margin of the shell there is a dark band of greyish blue in some and bluish brown in others; this colouring occupies precisely the same region as in the common clam *(M. casta)*. This is a very beautiful shell and the pity is that it is not more abundant. I have found it in the Silavathurai fish-farm at Tuticorin, in the seaward part of Pulicat Lake, and in a sub-fossil condition at Surla in Ganjām district. At Tuticorin it is fairly abundant, as a woman can easily collect from 30 to 40 in a tide. These clams are esteemed as food by the Valayans and Pallans who collect them and who use the empty shells for lime-burning. The flesh is considered less delicate than that of the common clam; the species seems less hardy; as a consequence its distribution is more local and

restricted—it requires a cleaner habitat than *M. casta* and a strong tidal current over the bed where it lives. Hence it is usually found near the entrance to lagoons, where the tidal flow is great. Spawning occurs about the beginning of September at Tuticorin, probably also about May.

The shell exhibits considerable variation in colouring; usually, apart from the postero-dorsal and umbonar regions, it exhibits no banding, but in a few (Tuticorin) there are very broad ill-defined radiating bands of a somewhat livid brown colour extending from the ventral margin to half way to the umbo. The umbo nearly always shows considerable colouring but this is extremely variable and no two shells are exactly alike in this respect. Most frequently a minute brownish speckling can be made out, either alone or associated with a more conspicuous and extensive zoning in a livid tint; in others this speckling resolves itself into a more distinct colouring of chevron-shaped chestnut markings, which may coalesce either into short rays or into concentric zones, never spreading far beyond the umbo.

THE BLACK CLAM—VELORITA COCHINENSIS (Hanley).

Malayalam—*Kar erunthu.*

This small thick-shelled clam is found only in west coast estuarine backwaters, where it is associated with the common clam (*Meretrix casta ovum*). Its shell is ribbed concentrically and covered by a coarse thick black periostracum which is frequently worn away by corrosion at the umbo, showing the whitish shell beneath. The interior is characteristically pale pink in tint. This clam can survive the prevalence of fresh-water conditions longer than the common clam; it was originally, I believe, a fresh-water species, and its presence in quantity in estuarine backwaters, subject during a considerable portion of the year to brackish water conditions, indicates a marked change in its habits and an acquired tolerance for saline conditions. It is used by the same people as eat the common clam and its valves are also employed in lime-burning in Malabar. It is not nearly so abundant as *Meretrix casta ovum*; its habitat is usually further distant from the sea than that of the latter species.

The shell seldom exceeds 40 mm. in length.

MURAL (DONAX CUNEATA Linn.).

Tamil—*Mural* (முறல்), Pulicat Lake; *Vāzhi matti* (வாழிமட்டி), Pāmbān.

This small, much compressed bivalve is roughly wedge-shaped in outline, the posterior part of the shell being obliquely truncate. It is abundant between tide-marks and for some short distance below low-water level. It never enters backwaters and is essentially a marine form. In size it seldom exceeds 40 mm. in length.

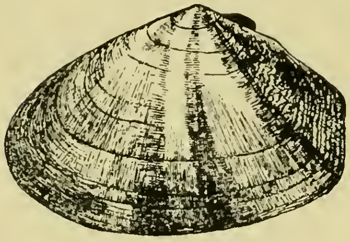

FIG. 5.—THE MURAL (*Donax cuneata* Linn). × 1¼.

On the east coast, the mural usually abounds in great numbers, particularly on surf beaten sand flats. On the Malabar coast it is also plentiful but is usually smaller. In Tamil districts, especially on the Coromandel coast, the mural is chiefly valued by the fisherfolk (Pattanavars, etc.) whose lads are accustomed to collect it when rough weather cuts off the usual supplies of sea fish. The mural serves largely to meet such an emergency. It is seldom collected for sale.

The mural lives in the surface layer of sand; the boys who collect it turn over the wet sand with their feet as the tide recedes.

As usual with Indian fishermen the flesh of the mural is used in curries; sometimes it is put in whole, but in the neighbourhood of Madras it is more frequently ground into a paste after being boiled and incorporated with other ingredients of the curry.

Like so many other Indian molluscs, two maximal spawning periods can be made out, April—May and September, respectively.

THE COCKLE CLAM (CIRCE GIBBA Lamk.).

Tamil—*Vari matti* (வரிமட்டி).

This shell is particularly plentiful in Palk Bay and the Gulf of Mannar where, especially in the former area, its collection is important to the Kadayans, Valayans and allied coast castes.

It is a strongly ribbed white shell with a superficial resemblance to the European cockle (*Cardium edule*)—the ridges running radially from the umbo to the margin—and of about the same average size. Its dimensions average when fully grown 45 × 37 mm. with a thickness of about 33 mm. It spawns about the beginning of September at Tuticorin. It frequents muddy sands

near low-tide level both along the open coast and in backwaters and estuaries. The flavour is good and the flesh tender.

Collection takes place at low water during spring tides, when the poorer women of the coast villages devote themselves to this work for two or three hours daily. In this time each can gather between 300 and 400 shells.

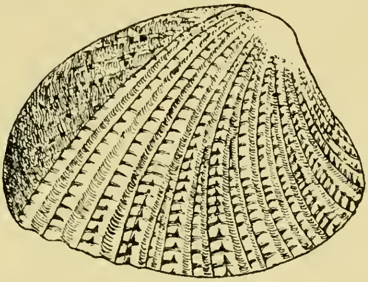

Fig. 6.—Circe gibba Lamk. Natural size.

The muddy flats between Pāmban and Kundagal Point are rich collecting grounds and many women may be often seen there engaged in the search at spring tide. Very frequently a couple of shells are kept in one hand and rubbed or struck against one another to produce a clicking sound. When questioned the women say that this has the effect of attracting the clams to the surface; they watch for a slight movement wherever they see clam burrows and scoop up the sand where this occurs, generally getting one or two shells. I am inclined to think that in reality the clicking sound has an opposite effect to that believed by the clammers; it really alarms the clam and causes it suddenly to retract its siphons and close its valves. In so doing a slight movement of the mud at the entrance to its burrow is necessarily caused and it is this that reveals its presence. Alphæids—the so-called "clicking prawns"—are common on these flats and possibly the noise made by striking two shells together is mistaken by the clams for the clicking of Alphæids.

The flesh is used either to form a curry, a soup, or a savoury, this considerable variety betokening the high esteem in which it is held. In all cases the preparatory operation is to steam the shells open and extract the flesh. This may then be made forthwith into a curry with the usual condiments, or it may be ground fine with coconut and spices, and boiled to form a highly tasty and nutritious soup, or, lastly, it may be ground to a paste, and fried in ghee or in sesamum oil and eaten with other food. The last mode

of preparation is a strong favourite with those who habitually utilize this food.

Probably no other bivalve is so universally valued on the shores of Palk Bay as is this cockle-clam—everybody seems fond of it with the exception of the higher caste Hindus.

The empty shells are used for lime-burning on the shores of Palk Bay, where it is the most abundant littoral mollusc. Along the Coromandel coast, *Circe gibba* is scarce and does not seem to be used there as food. It is not found on the Malabar coast.

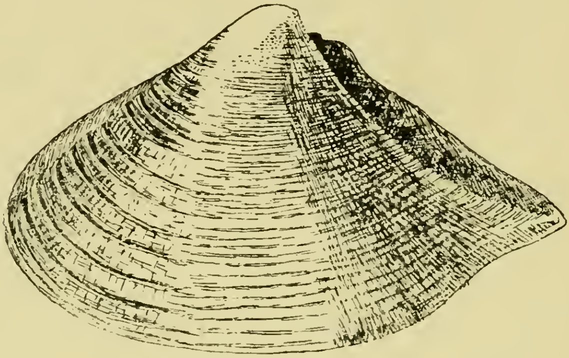

FIG. 7.—DONAX SCORTUM. × 1¼.

MISCELLANEOUS MARINE CLAMS.

Malayalam—*Oraikai*, Calicut.

Besides *Circe gibba* and *Donax cuneata*, a number of other marine bivalves, chiefly Mactrids and species of related families are taken for food when met with in the search for the first named. Among the principal of these are *Donax scortum*, a fine purple tinted species

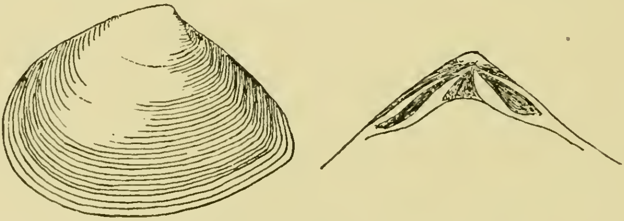

FIG. 8.—KAKKAMATTI (*Mesodesma glabratum*).
The figure on the right shows the structure of the hinge

growing to a length of 60 mm., strongly sculptured with coarse concentric ridges, and several species of *Mactra* and *Mesodesma*. One of the latter, called Kakkamatti (*Mesodesma glabratum*, Lamk.),

is pretty frequent along the island beaches near Pāmban and is fished and treated for food in the same way as *Circe gibba;* it grows to a length of 34 mm.; the shell, sculptured with bold concentric ridges, is white in colour, covered partially with a dirty yellow skin of periostracum (Fig. 8). The pretty little Sevala-matti *(Mactra corbiculoides* Desh.) tinted a deep violet colour within, is equally common in the same localities; its smooth shell is distinctly trigonal in outline, usually about 30 mm. in length, with deeply concave valves which are thus able to give accommodation to a body relatively much larger than is contained within the shallower valves of the Kakkamatti. Its colour is most distinctive; externally a bluish-grey with purplish blue colouring showing through at the umbo and usually another similar colour band within the margin; internally the whole surface is characteristically tinted violet. When partially bleached, the colour fades to a warm pink, whence the local name of *Sevala matti* (red matti). Like all Mactrids a portion of the ligament is contained in a centrally placed deep pit or fossette within the hinge and immediately under the umbo (Fig. 9).

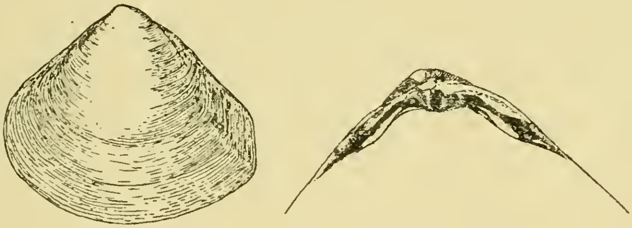

FIG. 9.—SEVALA MATTI *(Mactra corbiculoides).*
Inner view of hinge on the right.

A handsome inflated form of Tapes *(Tapes ceylonensis* Sow.), called *Vazhukkumatti* in the neighbourhood of Pāmban is fished with the foregoing. It has a superficial resemblance to the backwater clam *Meretrix casta*, being about the same size, shape and colour (Fig. 10); it differs however in having pale radiating bands of darker tint on each valve running from the umbo to the margin and instead of having

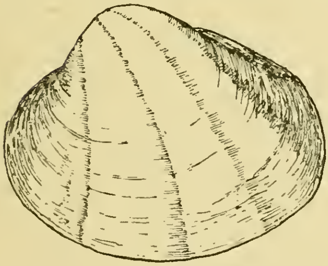

FIG. 10.—VAZHUKKUMATTI *(Tapes ceylonensis* Sow.).

a very small pallial sinus it has one well-marked, deep, and angular Average length 44 mm.

FRESH-WATER MUSSEL (LAMELLIDENS MARGINALIS Lamk.).

Although this common Indian species, identical with the text-book type so well known to biological students under the name

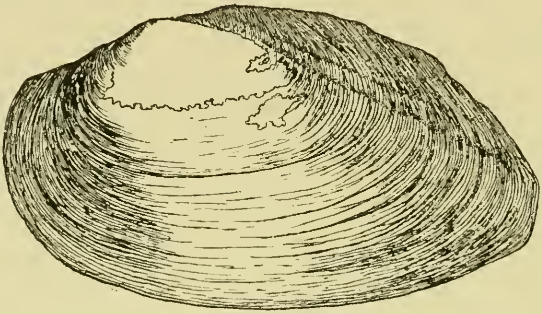

FIG. 11.—LAMELLIDENS MARGINALIS, VAR. CORIANUS (Lea).

of Unio, is very widely distributed throughout the Presidency, it finds little favour as food. Only low castes care to eat it, but in Ganjām, Tinnevelly and some other districts considerable quantities are consumed when obtainable in abundance.

Both in Ganjām and Vizagapatam districts, the valves are used extensively as instruments for peeling mangoes. To prepare one a hole is made in the convex umbonar region by rubbing this part of a valve—usually a right one—upon a stone till a hole of the right size is obtained; to use the peeler thus formed, it is grasped in the hand with the hollow side towards the palm, and then one edge of the hole is used to peel off strips of skin. The advantage claimed for this implement over a knife is that the mango does not become stained from contact with steel.

It seems probable that the valve of a fresh-water mussel, having a large hole in the centre, figured in Bruce Foote's "Catalogue of Prehistoric and Protohistoric Antiquities," Madras, 1915, under the number 234-129, from Narsipur-Sangam, Mysore, is a mango scraper of this kind, and not part of a shell necklace as surmised by the author named.

This species, although its shell is usually too thin to be of any use in pearl button manufacture, sometimes produces pearls in considerable quantity of fair value. Occasionally they are offered in the Surada Bazar (Ganjām); these are obtained from a great irrigation reservoir in the neighbourhood wherein these mussels flourish, growing to a length of about three inches. The pearls have a reddish tint and less lustre than those from the marine pearl oyster.

GASTROPODS.

Compared with bivalves, gastropod molluscs are of restricted and purely local importance. None seem to be used as food on the Malabar littoral and one only upon the Coromandel coast. Only on the Ramnad and Tinnevelly coasts are several species used to any extent. Neither is the list a long one, limited as it is to the common chank *(Turbinella pyrum)*, the five-fingered chank *(Pterocera lambis)*, the olive *(Oliva gibbosa)*, the turban shell *(Turbo margaritaceus)*, as the ones in common use, with *Strombus*, *Conus* and *Murex* occasionally. The reason is that, with the exception of the common chank and the olive, few gastropods are found in quantity outside of Palk Bay and the Gulf of Mannar; on the Malabar coast, except rarely and very locally, no species abounds in shallow water, and the same may be said of the shores of Vizagapatam and Ganjām.

THE SACRED CHANK (TURBINELLA PYRUM Linn.).

Tamil—*Sangu* (சங்கு), Tinnevelly and Ramnad districts; *Palsangu* (பால்சங்கு), Chingleput district.

The common or sacred chank, fished in hundreds of thousands for sale to the shell-bangle workers of Bengal, is the most abundant large Gastropod in the Presidency. It brings in a large annual revenue, now amounting to close upon half a lakh of rupees (net) to the Madras Government, and promises to yield a largely increased sum as the organization of the fishery progresses.

As an article of food the flesh has come into local prominence only since the great famine of 1877 when the families of Parawa chank divers of Tuticorin first made systematic use of it. On the run home from the fishing grounds, the divers extract the foot and head region from the shell, using a strong iron skewer for the

purpose. The whole of the glandular tissue in the "tail" of the mollusc is left within the shell. The part extracted is chiefly muscular tissue and carries the large horny operculum. This meat, called *sangu sathai* (சங்கு சதை), is collected in little palmyra leaf

FIG. 12.—THE SACRED CHANK (*Turbinella pyrum* Linn.). × ¾.

baskets and taken home as soon as the shells have been handed over to the Government officers. In preparing it, the flesh is boiled, cooled, and then, after pulling off the operculum, cut into thin transverse slices which are sun-dried. In this condition they keep indefinitely—hard and horny slices looking like very thin chipped potatoes. In cooking, the slices are fried in ghee or gingelly oil. The quantity consumed must be considerable, for at Tuticorin—where alone a systematic use of the flesh is made—the number of shells so treated amounts to an average of over 250,000 yearly. The bulk of the flesh is consumed by the divers' own families; any surplus is readily saleable within the limits of the caste; none is

ever seen in the markets. The value of the flesh is 12 annas per measure.

In the chank fishery carried on off Rāmēswaram a small quantity of the shells are treated in the same way by Muhammadan divers, who saw some of the Tuticorin men treating the shells thus at the 1915 fishery and who are now beginning to use the flesh similarly. As yet comparatively few chanks have their flesh extracted at Rāmēswaram but the practice will probably gradually become general as a taste for the article is acquired.

Fig. 13.—Egg capsule of the Sacred Chank. × ⅔.

The Pattanavars of the Pulicat fishing hamlets occasionally catch chanks in their thûri nets; the village youngsters are said to be fond of the flesh, eating it after boiling. So few shells are found that the flesh has no market value.

The operculum (Tamil, *naganam* or *navanam*, நாகணம், நாவணம்) of the chank has considerable value, being in demand for use as a glue in the composition of incense sticks. Large quantities are collected from the shells at Tuticorin and Rāmēswaram and sold at the rate of from Re. 1–2–0 to Re. 1–6–0 per pound.

At Rāmēswaram some of the Muhammadan divers make a speciality of this work; they go round during the time of counting and gauging the shells, tearing off the opercula of all those that they can get permission to handle. They use a pair of home-made flat-nosed pliers for the purpose.

For a description of the Chank and its varied uses see "The Sacred Chank of India," constituting Bulletin No. 7 of the Madras Fisheries Department (Government Press, Madras, 1915).

THE FIVE-FINGERED CHANK (PTEROCERA LAMBIS Linn.).

Tamil—*Aiviral sangu* (ஐவிரல் சங்கு), Ramnad district.

This species of Pterocera, the most common of the genus, is very abundant in the faunistically rich shallows of the south-western angle of Palk Bay. From low water to two fathoms, this shell is often numerous, particularly along the coast between Pāmban and Tondi. Some are collected by the shore people wading in the sea at low tide, but the great majority are taken either by the Kadayan and Muhammadan bêche-de-mer divers or accidentally in nets set for crabs, whereof many miles length are shot daily during the season. The shells serve a variety of purposes; as food they are broken open and the flesh extracted, and used for curries; as net sinkers they have the "fingers" broken off, the shell perforated and then are tied at intervals along the ground rope of nets; by burning, whitewash lime is made; lastly they are used as octopus traps. To fit them for the last-named use, the apex of each shell is broken off together with the fingers, and are then attached at intervals of 5 or 6 feet along a rope to which as many as 30 shells may be thus fastened. A number of ropes are tied end to end and laid in shallow water overnight; when raised next morning a number of small octopus are found sheltering in the cavities of the shells. These are used as bait when lining for such fish as seer, parai, dogfish and rays. Hundreds of these shell-trap lines are in use on the Ramnad coast from Devipatam northwards. In Japan a device on the same principle is used for a similar purpose; in place of *Pterocera* shells, the Japanese use narrow-necked vase-shaped earthenware pots, tied at intervals by the neck to a strong line.

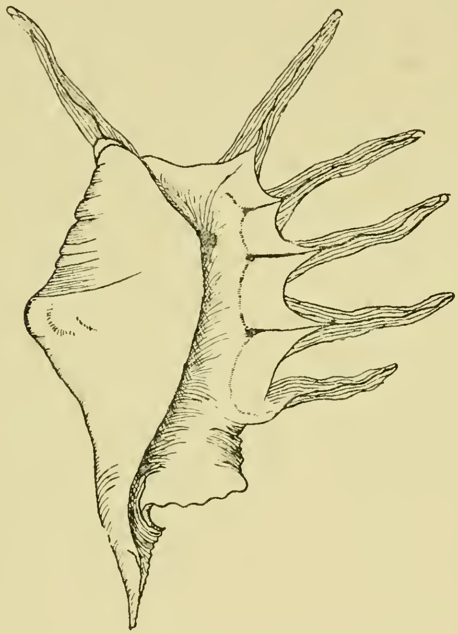

FIG. 14.—THE FIVE-FINGERED CHANK (*Pterocera lambis* Linn.).

THE TURBAN SHELL (TURBO MARGARITACEUS Linn.).

Tamil—*Nathai* (நத்தை), Pāmban.

This small species of Turbo, allied to the well-known mother-of-pearl shell called "Green Snail" in trade, is found in abundance on the surf-washed rocky shoals found here and there on the coral reefs near Pāmban. The island women collect the shells

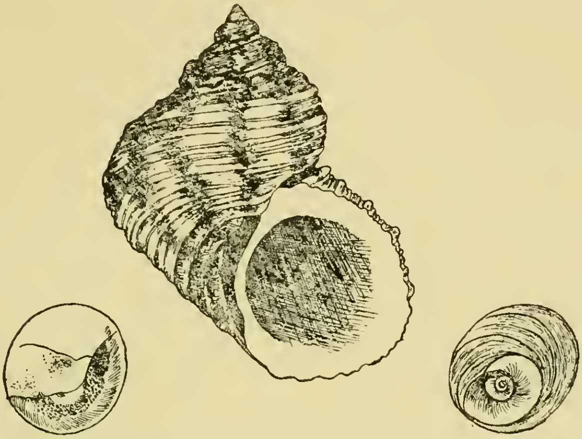

FIG. 15.—THE COMMON TURBAN SHELL (*T. margaritaceus*) WITH OUTER AND INNER VIEWS OF THE OPERCULUM. × 1.

during spring tides when the shoals uncover for a short time; they employ all the available minutes in turning as many stones as possible, this being the favourite habitat of Turbo. The flesh is used in the same way as that of the cockle-clam.

Besides the value of the flesh, Turbo is esteemed for its operculum. This is a stout, disc-shaped stony body, flat on the inner surface, strongly convex on the outer; it serves as a defensive stopper when the animal is attacked, the soft body being retracted wholly within the snail-shaped shell and the aperture closed by the hard body of the operculum. All sorts of shells and marine objects are stocked in several booths within the main entrance to the Rāmēswaram temple, for sale to the thousands of pilgrims who travel thither from all parts of India, and among these objects the opercula of Turbo find place. The best ones are retailed at 8 annas per hundred, sea-worn ones collected on the beach at considerably less. The island women (Valayans chiefly) get about 8 annas per measure from the Rāmēswaram shopkeepers. The Tamil name for them is *ambiliman* (அம்பிலிமான்) signifying the disk of the moon.

The Top Shells (Trochus spp.).

Tamil—*Thalappaikatti* (தலப்பாய் கட்டி), Pāmban.

Several species of top-shells but chiefly *T. radiatus* Gmel., are occasionally fished along with Turbo in the neighbourhood of Pāmban. The flesh is not valued owing to the small size of the shells and the difficulty of extracting the body. Sometimes when there is nothing else to be had for their curry and Trochus is abundant, Valayan women collect the shells at low water, and cook the flesh in the same way as that of Turbo. A small incentive to the collection of these shells is the fact that the shell dealers in Rāmēswaram temple give two annas a measure for the shells.

The Olive Shell (Oliva gibbosa Born).

Tamil—*Kovanji* (கோவஞ்சி), Palk Bay ; *Sangu* (சங்கு), Pulicat.

This small spindle-shaped shell, noted for its high polish and the beauty of its marbled colouring, is very common about low-water level on all sandy shores on the east coast ; it is rarely seen in Malabar. On the Coromandel coast it is extensively used as food by the Pattanavar or sea-fishermen caste. On the Ramnad coast it has less importance as a minor food item ; while utilized, chiefly by Valayans, in the same way as other shellfish whenever found, it is in some cases sought for separately on account of the price the shells fetch when sold to the shell dealers in Rāmēswaram temple, who give an anna per hundred for the shells.

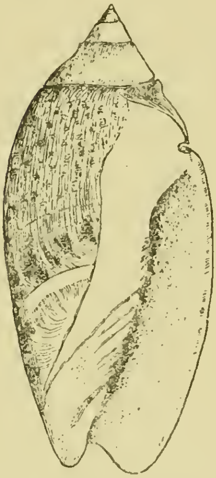

Fig. 16.—The Common Olive *(Oliva gibbosa)*. × 1.

On the Coromandel coast, the chief collecting season is at the times of spring tides during the fine weather period from February to April. Towards the end of the ebb tide Pattanavar women and lads then engage in the search, from about extreme low water to a depth of a couple of feet. They find the shells by turning the sand over with the foot or in the case of those in the uncovered sand by marking the trail made as the Olive travels about.

The Pattanavars boil their catch in fresh water, extract the flesh and then either use it in their curry or fry it in oil.

The size of these Olives runs from 50 to 60 millimetres in length. In the sea-fishing hamlets or kuppams in the neighbourhood of Pulicat Lake, their shells, with those of Donax, contribute no inconsiderable bulk to the kuppam kitchen middens there accumulating.

Rock Whelks (Purpura rudolphi, Lamk. and P. bufo, Lamk.).

Tamil—*Par attai* (பார் அட்டை), Pamban.

These shells measuring about 50 millimetres in length, are found along with Turbo on the shingle and stone strewn shoals of the islands and mainland of Ramnad district. They are not

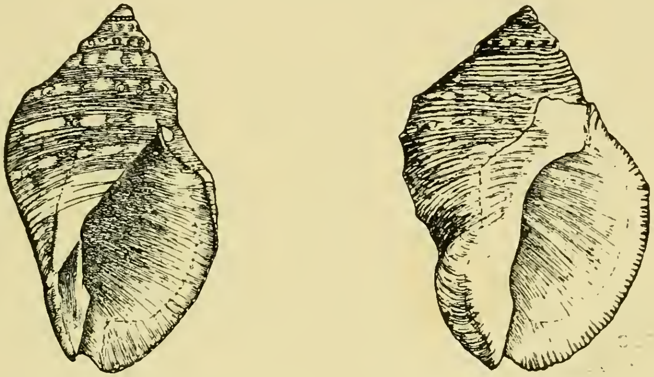

Fig. 17.—Purpura rudolphi, Lamk., and Purpura bufo, Lamk. × 1.

specially collected, but any found during the search for Turbo are kept and cooked along with the latter by the Valayans who are the chief inhabitants of the Ramnad islands. Other castes are said not to eat these species.

Strombus and Conus.

None of these shells is ever regularly collected for food purposes, but on the Ramnad coast and the adjacent islands, the poorer shore people when gathering other shells take any they find and cook them with the rest.

The shells of the mottled Wing-shell (*Strombus canarium*) have some value independent of food purposes; large numbers are used annually at Kilakarai by shell-ring makers in their trade. These men who are all Muhammadans, pursue the most primitive methods, such as we can understand prehistoric men employing. The two ends of the shell are first broken down by means of a hammer

and chisel and then the resultant middle section is ground down laboriously upon a stone.

Except a hammer, a chisel, and a file used to smooth the edges, no other tool is employed. These rings, known as *sangu modiram*,

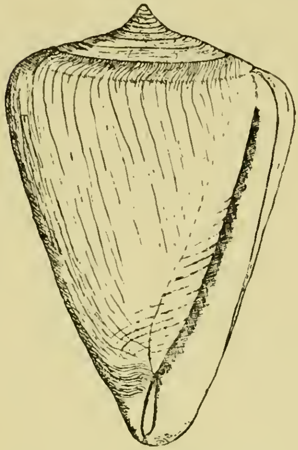

FIG. 18.—A CONE-SHELL.

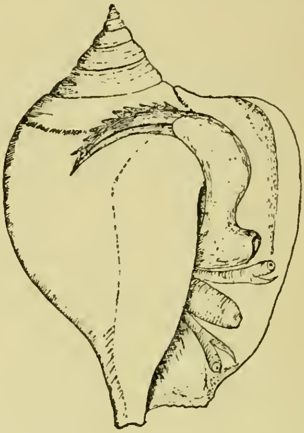

FIG. 19.—THE MOTTLED WING-SHELL (*Strombus canarium*). × 1.

are extensively used as finger rings throughout the Tamil country as a specific against skin eruptions. In the Malabar and South Kanara districts certain classes of the poor population—Pulayas, Holayas and some Mukkuvans—use these rings in the making of necklaces for their women and children.

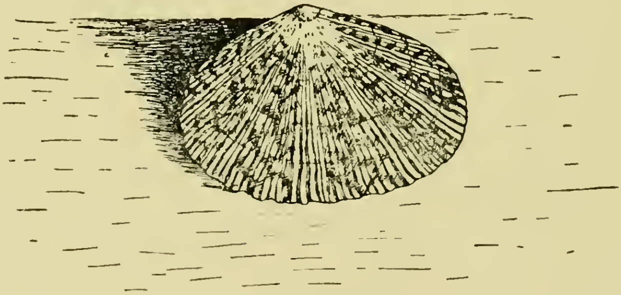

FIG. 20.—A LIMPET ATTACHED TO A ROCKY SURFACE.

LIMPETS—(PATELLA spp.).

Tamil—*Unai* (ஊணை), Covelong, Chingleput district.

Wherever fairly smooth-surfaced rocks are exposed to surf

action between tide marks on the east coast, small limpets can usually be found. The rocks off the beach at Covelong, Chingleput district, are where I have seen them most numerous and there some of the poorer among the fisher people are accustomed to collect them for food. They are also to be seen on the rocks at Mandapam but no use seems to be made of them. The available suitable ground is too limited in this Presidency to permit this shell-fish to be put to extensive use.

Fresh-water Snails (Ampullaria and Vivipara).

Tamil—*Nathai* (நத்தை) for Ampullaria; *Umachchi* (ஊமச்சி) for Vivipara.

Large brown water-snails belonging to the genus *Ampullaria* are abundant in fresh-water marshes and ponds, as well as in paddy fields where they are often seen in great numbers and up to 1½″ diameter as a usual size. Throughout the Presidency they are collected after the paddy has been harvested and the fields run dry, by low caste women who use them to help out their ordinary meals. They are also used medicinally for sore eyes.

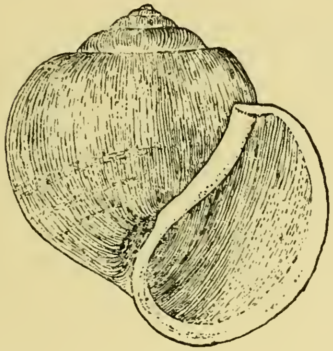

Fig. 21.—The brown water-snail (*Ampullaria*). Natural size.

Seale states that in Manila and other Philippine towns large quantities are sold at an average price of 1½ anna per kilogramme.

Vivipara, another common but much smaller fresh-water snail, is also used to some extent as food in the Southern Tamil districts, being gathered in ponds, marshes and paddy fields in company with the larger Ampullaria. It is less esteemed than *nathai*, being both smaller and less succulent.

In preparing all fresh-water snails for food, it is essential to remember that care should be taken to cook them thoroughly, as some species in other countries are known to harbour larvæ of certain parasitic worms which cause dangerous diseases if they pass alive into a new host. In England and elsewhere the small pond-snail *Limnaea* is often infested with the young of the liver-fluke, a parasitic flat worm which causes much disease among sheep

when pastured in marshy meadows, whilst in Egypt a common and dangerous human disease induced by the presence of the parasitic worm *Bilharzia*, has recently been traced to the infection of another fresh-water snail belonging to the genus *Planorbis*. Parallel cases of disease transmitted to man through the agency of fresh-water snails have not yet been traced in India, but whether this is due to lack of attention to this possible source of disease or whether to the excellent custom prevailing generally throughout India of eating no animal food except it be cooked, it is not yet possible to say.

CEPHALOPODA.

Octopus, Squid and Cuttlefish.

Three species of Cephalapods have considerable economic importance in the Presidency but the locality where they are caught in abundance, is much circumscribed, and is limited virtually to the confines of Palk Bay. The two most abundant and most valuable forms belong respectively to the genera *Loligo* and *Octopus*, a medium-sized species of Squid (*Loligo*) being caught in great quantities in nets and by jigging, while a small species of *Octopus* (*Polypus*) is taken largely in shell traps. The third is a Cuttlefish (*Sepia*) not caught in abundance but of some value for its " bones " which are thrown ashore in considerable quantity. A trade opening probably exists for the introduction of methods of cure which will enhance the selling value of these highly nutritious and tasty marine products.

Besides these, at least two other kinds of Octopus are occasionally caught and eaten.

The Common Squid—(Loligo sp.).

Tamil—*Kundal Kanavai* (கூந்தல் கணவாய்), Rameswaram Island ; *Eekki Kanavai* (ஈக்கி கணவாய்), west coast of Palk Bay.

The species represented under these vernacular names is the only large Squid found in abundance in Palk Bay. Shoals appear in shallow water off Rameswaram Island about April and during the month preceding the burst of the monsoon—about 15th June—the shoals reach their maximum, and then consist of immense assemblages of individuals sheltering under the lee of the land, to feed upon the smaller fry that seek similar shelter, and to deposit their egg capsules among the weeds common in the places favoured.

Two methods of fishing are employed, the one a wholesale netting in which thousands are caught at a haul; the other, where the skill of the fishermen is exercised in catching the Squid singly by means of a jigger.

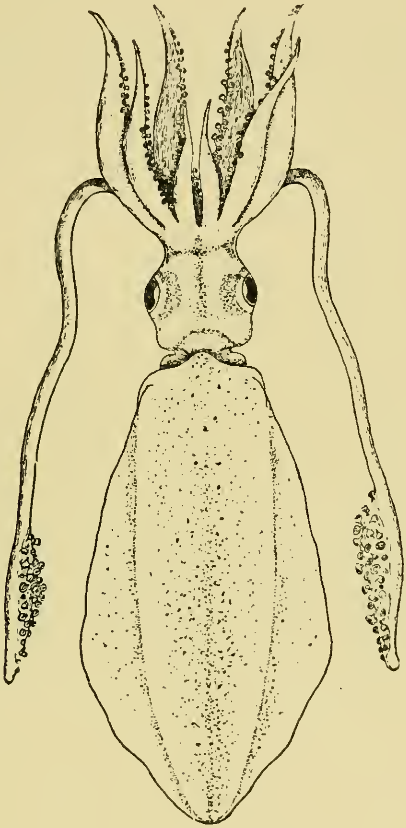

FIG. 22.—THE COMMON SQUID. × 1/3.

The first method is largely practised in Rameswaram Bay during the early part of the south-west monsoon; a seine is used having a large close-meshed bag in the centre, with long wings and with wing ropes closely set with strips of palm leaf (olai) to serve as scare lines, and so to herd the Squid into the bunt of the net. In the season there are usually four sets of these Squid seines—called *olai-valai* locally—in daily use at Rameswaram. When shoals are about catches may occasionally range up to 5,000 a haul. The bulk of the Squid caught are sold to fish runners who come from Pamban

at rates varying from Re. 1-12-0 to Rs. 2-8-0 per 100; the balance is consumed locally. When demand is weak and little is sold for consumption fresh, the Squids are sundried and sold eventually at Ramnad and other inland markets at about Rs. 3 per 100.

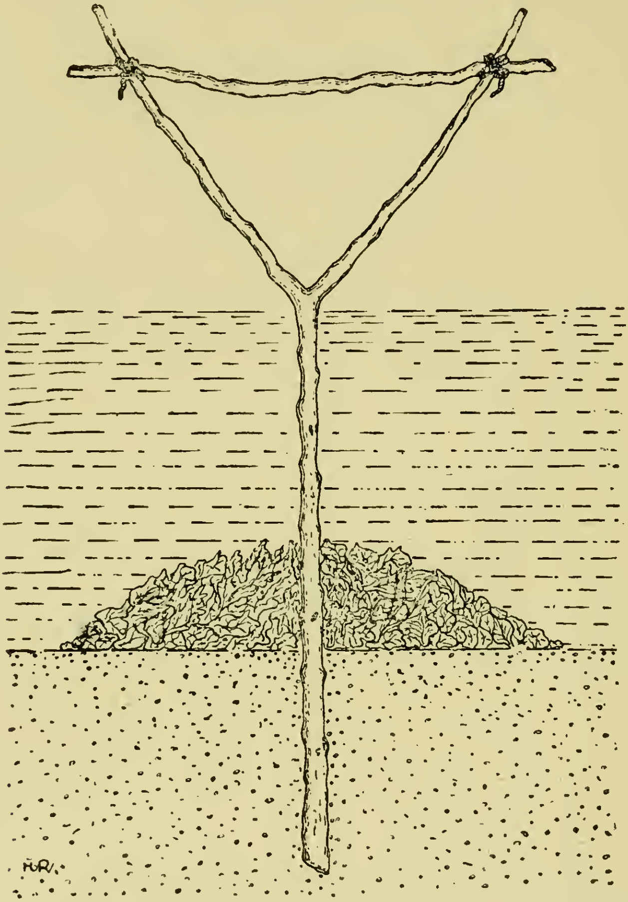

FIG. 23.—FISHING PLATFORM USED AT RAMESWARAM WHEN JIGGING FOR SQUID.

Jigging for Squid is practised chiefly for home requirements by individual fishermen, who sun-dry any surplus they may have. This method is largely employed along the northern coast of Rameswaram Island, especially at Rameswaram and at Aryakundu, near Thangachimadam, during the Squid season. To carry it on the fisherman erects a small outlook in shallow water—a form of machan (Fig. 23). The main portion of the structure consists of a stout bifurcated tree branch of Y-shape, the main stem

embedded firmly in the sea-bottom; across the ends of the two arms which project upwards several feet above the surface of the water, a strong pole is fixed horizontally to serve as a rest for the fishermen. The height of this seat above the sea-bottom is generally about 6 feet; 8 feet at the utmost. A pile of leaves is tied or anchored at the foot of the staging to attract the squid; the fisherman when ready, takes his stand on his outlook armed with a slender pole 12 to 15 feet long, furnished at one end with 5 or 6 stout hooks set grapnel fashion, thus (Fig. 24):—

Fig 24.—Squid Jigger.

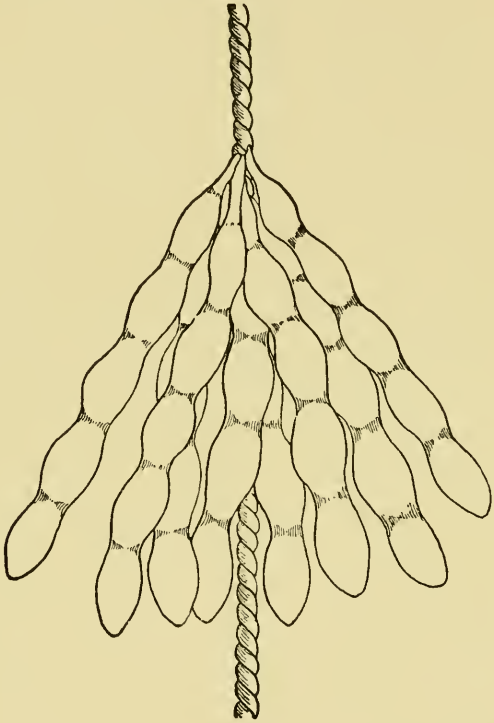

Fig. 25.—Egg Capsules of a Squid attached to a submerged rope. Half natural size

Watching the bottom intently, the fisherman waits till he sees a squid approach to investigate the heap of leaves. As soon as it comes within range he cautiously moves his jigger into a favourable position and with a deft jerk imbeds the jigger hooks in its flesh and lifts it from the water. The reason why the Squid seek shelter amid the leaves set as a lure, seems, on the part of the female, to be for the purpose of laying her eggs therein, as she requires such

objects whereto to attach the great gelatinous candle-like capsules in which the ova develop (Fig. 25). The male is said to follow the female at this time, so that sometimes both fall a prey to the fisherman's jigger. What is not used or sold immediately is split open, washed and sundried; it makes a very clean and attractive-looking product.

This method of fishing is generally carried on in the morning, the fisherman occupying his outlook for four or five hours at a stretch. The branched post employed is cut generally from a babul thorn, the one tree that manages to thrive well on this sun-scorched sandy coast. At Rameswaram there are often as many as one hundred of these Squid machans in use.

CUTTLEFISH (SEPIA).

Tamil—*Ottu Kanavai* (ஓட்டு கணவாய்), Palk Bay.

Cuttlefish are far less abundant than Squid in Palk Bay and are not the object of any special fishery, though some are occasionally taken in the casting net (*vichchu valai*) and in drift net and shores seines. Their "bones" are however thrown up in large quantities on the southern and south-western shores of Palk Bay during the north-east monsoon, and at this period of the year, numbers of Kadayan women scour the littoral in their search. After long continued northerly winds, the supply is often very abundant during November and December at Rameswaram, and after easterly winds (March and April) at Tirupalagudi and Tondi; a woman can collect several hundreds in a day. These are eventually sold to agents of Kilakarai, Devakottai and Pamban merchants who tour the coast to buy up the stocks available. A gunny bag full of cuttle bone of all sizes fetches from ten annas to Rc. 1-4-0; sometimes they are sold by number and

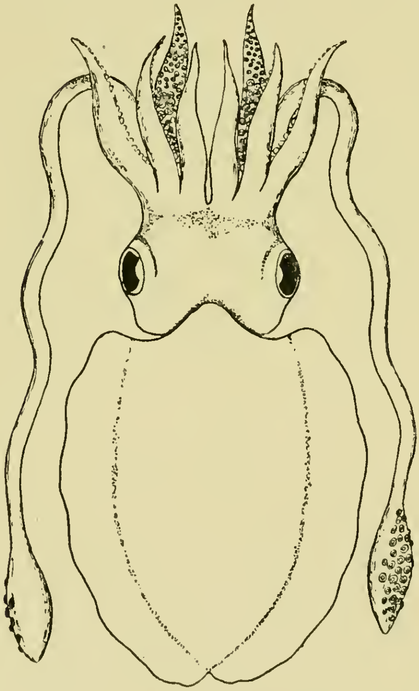

FIG. 26—A CUTTLEFISH (*Sepia*). × ⅓

size, the price varying from two to eight annas per 100; a common price is one pie (one-twelfth anna) for large bones and two or three per pie for small ones. A regular price cannot be said to exist; rates vary with the needs of the seller and of the purchaser.

On the south coast of Rameswaram and other islands near Pamban, cuttle bones come ashore during the south-west monsoon but not nearly so plentifully—only about one-tenth the quantity—as they do on the north coast of Rameswaram during the north-east monsoon. In a single season the collection of cuttle bones from Rameswaram Island alone amounts to from 10 to 14 cwt., a quantity representing a very large number of bones. The total Indian export amounts to a considerably larger quantity. Several fishing villages on the mainland, such as Morepanai near Uppur, report an annual collection of 20 to 50 bags each per annum. A considerable quantity is also obtained from the Travancore and Malabar coasts; most of this is exported through Tuticorin. From Kilakarai 14½ cwt. were shipped to Colombo during 1914–15.

A considerable demand exists in Europe for cuttle bone, especially for large sizes. From information received from a London dealer in this product, it is readily saleable there at £2–16–0 per cwt. delivered c.i.f. in London, in the case of large selected bones (8 to 12 inches long and above) and £1–8–0 per cwt. for bones of mixed sizes from 12 inches down to small pieces of about 2 to 3 inches, with at least half the bulk between 6 and 12 inches long. Care should be taken to ensure the bone being perfectly dry when packed, in order to prevent mould appearing.

Palk Bay fishermen cherish the belief that cuttlefish cast their bones annually at the season when they are thrown ashore in great quantity. Strangely enough no shoals of cuttlefish are ever caught in nets—only stray individuals; that large shoals do abound is evident, for it occasionally happens after a severe storm that very great numbers are thrown up on the beach, dead but quite fresh. The village women collect them, cure them in the sun and take to market where they generally find a ready sale.

THE SMALL DEVILFISH (OCTOPUS sp.).

Tamil—*Sa Kanavai* (சா கணவாய்), Rameswaram Island; *Pey Kanavai* (பேய் கணவாய்) and *Sangu Kanavai* (சங்கு கணவாய்), west coast of Palk Bay.

This is a small species caught solely for use as bait. It swarms in the weedy shallows of Palk Bay. It is in keen demand by line

fishermen as it makes the best bait known to them—its flesh firm and not easily pulled from a hook and its odour tempting beyond measure to the fish sought after.

To capture it, long lines are prepared having some hundreds of a large Pterocera shell (*P. lambis*) attached at short intervals, after having the apices and "fingers" broken off. These lines are sunk on the bottom in places which this Octopus frequents, and when lifted each morning many of the shells are tenanted by Octopods that have sought concealment therein.

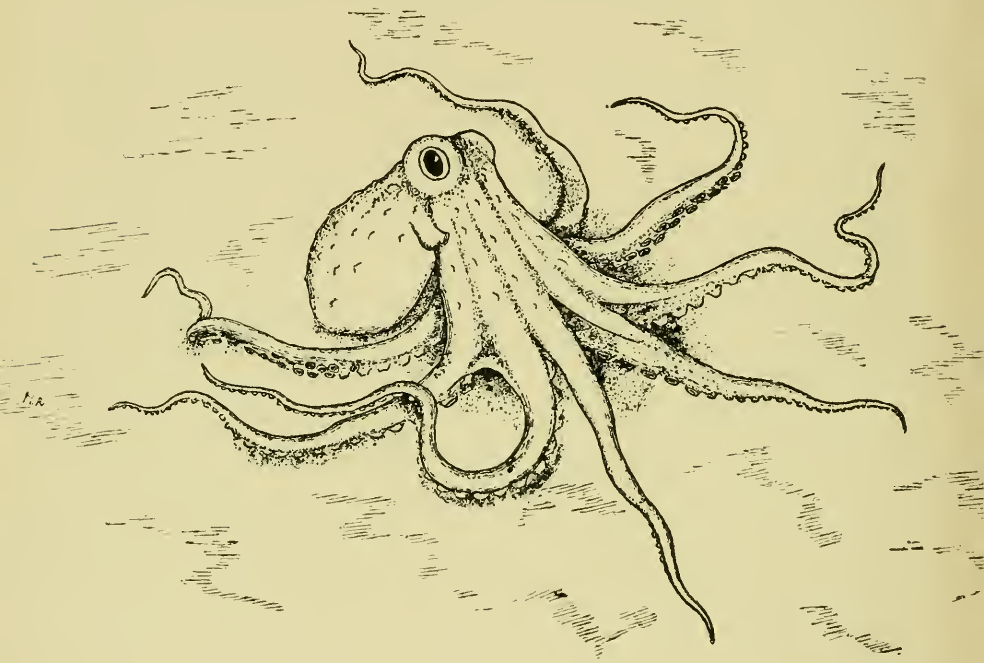

FIG. 27.—THE SMALL DEVILFISH (*Octopus* sp.). Natural size.

Every village on the Ramnad mainland fronting Palk Bay possesses these octopus lines, and the number of octopus thus caught is very great indeed; the industry is an important one both in itself and because of the dependence thereon of the line fishermen, who find it difficult to get other suitable bait if it be wanting. This bait fishery is said to have existed at Rameswaram a decade ago, being given up when line fishermen abandoned this occupation, because, according to some, their boats being small and unseaworthy, fishing on the offshore banks was found to be too dangerous for these timid and unenterprising souls.

The number of shell traps used on a Devilfish long line usually run to upwards of 800. The crew of a line-fishing boat on the Tirupalagudi coast consists normally of five men, and each of them when he joins brings 5 or 6 short lines, each armed with from 25 to 30 shells, say a total of 150 to 180 per man, or a grand total of 25 to 30 lines carrying 700 to 900 shells in all. The lines tied end to end are laid out in a depth of 2½ to 3 fathoms of water, one end being buoyed with a large wooden float. Each morning the fishermen haul the lines and the attached shell-traps; so common are these small Devilfish that a considerable number of the shells are tenanted by them. Enough for the day's requirement of bait are removed, the line and its traps are relaid, and the fishermen proceed to bait their fish hooks with the captured octopus.

Every third week or thereabouts the lines are brought ashore and dried for a day to prevent rotting and then relaid for a further active period. At the beginning of the rainy season, lines are brought ashore, dried, and stored till the rains are over.

The most frequent name used for this creature is *Pey Kanavai*—literally "Devil squid"—the exact equivalent indeed of "Devil-fish," the popular English name of the Octopus. The fishermen say they call it so, because of the devilish restlessness which it exhibits when taken from the water and the impression of concentrated malignity which its appearance and habits make upon them. Often on the Pearl Banks, I have come across small ones hiding in empty pearl oyster shells; they certainly do appear uncanny in their activity when attempting to escape; they dash hither and thither like some great fleshy spider of the sea, their arms writhe and twist with a speed the eye cannot follow; small as these are, the play of the little suckers closely set over the arms is unpleasant on the skin and to restrain them is as difficult as to hold a globule of quicksilver. Their eyes, huge for their size, are too human to be pleasant, and it is no wonder the fishermen think they have a devil's malevolence and ingenuity. They credit them too with a great deal of sagacity; amongst other clever tricks attributed to them, is that when they enter an empty shell, they are careful to close the entrance with a shell or piece of stone, as a screen against their enemies, the crabs. I cannot vouch for the truth of this story, but I think it may quite probably be true. They are also said to sham death when they realize that they are finally cornered.

The Poisonous Devilfish (Octopus sp.).

Tamil—*Visha kanavai* (விஷ கணவாய்).

Another species of small Octopus called *Visha kanavai* (literally "poisonous kanavai") is occasionally caught in shell traps in the relative proportion of one or two per cent to the number of the *Pey kanavai.* The fishermen make no use of it as they say no fish will take it as bait. I have not seen it alive, but from dead specimens it is seen to be a slender-armed Octopus, looking very much like an immature example of the larger Octopod called *Kundal kanavai* at Tirupalagudi.

The common belief is strong that it is endowed with marked poisonous qualities; when caught it is usually thrown overboard at once. The fishermen say that it is equally active as the *Pey kanavai* and if it has the chance will fasten on a man's leg or foot and bite through the skin. The sensation is likened to the sting of a scorpion and if a remedy is not quickly applied, the limb will swell and a feeling of giddiness will be experienced. The accepted remedy is a curious one; betel juice is expectorated upon the place or chunam (slaked lime) smeared over the wound as soon as possible. Then, when shore is reached, jaggery (palm sugar) is rubbed over the place bitten and a dog being brought, is induced to lick the jaggery off; in so doing, it is believed that the poison will also be removed. In spite of this curious and complicated treatment, the effects of the poison are said sometimes to be experienced for several months afterwards, the usual complaint being that of a continued swelling of the leg bitten.

Although the bite of the *Visha kanavai* is esteemed so poisonous, the flesh is considered innocuous and when accidentally brought ashore with other species, it is cooked and eaten together with them.

UNUTILIZED SPECIES.

Besides the kinds of shellfish above enumerated, which are themselves only partially utilized for food supply on the Madras coasts, there are several others, often occurring in considerable abundance, that are not eaten in this Presidency although they are all wholesome, highly nutritious and freely used as food in other parts of the world. This difference in habit appears to have a racial significance, for, of the Asiatic races, it is those of Mongolian stock which exhibit real and keen liking for such food. The Dravidians of India appear to have no innate liking for shellfish ;

wherever they do use it, such employment seems to spring either from an acquired taste or to be due to the compulsion of poverty directing attention to a cheap source of food supply. In China, Japan, the Philippine Islands and generally throughout the Malay Archipelago, the markets of all large seaboard towns abound daily with many kinds of shellfish, and in numerous towns, such as Manila, the labouring classes depend largely upon this source for their daily food. It may be noted here that, so far as I know, there are no poisonous species found on the Indian coasts; all are edible and when gastric troubles do occur it is due almost entirely either to individual and abnormal susceptibility or intolerance, or, much more frequently, to unsuitable methods of cooking whereby the food is rendered tough and difficult of digestion. Light steaming is on the whole the most digestible method of preparation for bivalves; they may either be eaten without further preparation or else stewed for a prolonged time with appropriate flavourings. To those with good digestion, they may be made into more high seasoned dishes, such as curries, or fried or baked in butter or ghee (preferably) or in vegetable oils.

THE PEARL OYSTER (MARGARITIFERA VULGARIS).

Tamil—*Mutthu chippi* (முத்து சிப்பி).

Hitherto the local pearl oyster has been esteemed solely for the pearls it occasionally produces. At a pearl fishery the feverish eagerness of the search for these prizes is so intense that the food value of the flesh is forgotten. This however is very considerable, for it is both tender, well-flavoured and highly nutritious; in these qualities it is about on a par with the Scallops (Pectinidæ) of Europe and may appropriately be cooked by the same methods.

The shell grows to a sufficiently large size to accommodate a body ample enough to repay a cook's attention. The size usually attained is 75 millimetres in length by an equal depth from hinge to ventral margin. The glandular tissues (gonads and digestive glands) are greatly developed in healthy individuals and make the flesh highly nutritious and tonic. Its food value may be considered fully equal to that of the edible oyster; it is however rather richer in fat content and in the cooked condition sweeter and more like in flavour to the scallop. It is most excellent whether scalloped, stewed, baked, or curried, and in my opinion is the finest of Indian shellfish. If ever a fish cannery be established on the shores of the

Gulf of Mannar, I believe that in those years when pearl oysters are poor in pearls though abundant numerically, the canning of their flesh would prove a remunerative undertaking. For details of the anatomy, see Herdman and Hornell in *Ceylon Pearl Fishery Reports*, volume II, page 37.

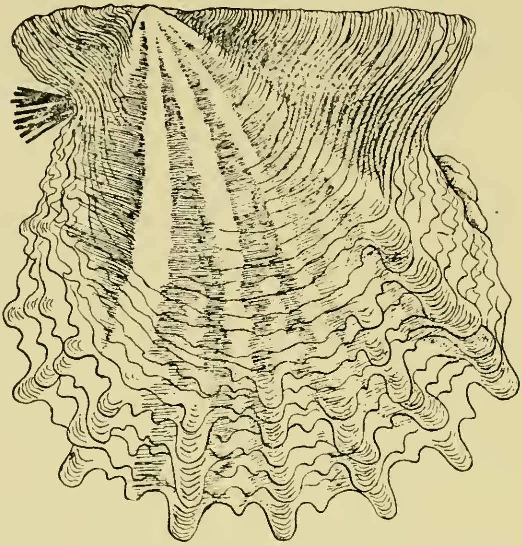

FIG. 28.—THE INDIAN PEARL-OYSTER. Natural size.

Its permanent habitat in Indian waters seems to be the shallows of Palk Bay where extensive beds, comparatively thinly populated, exist in several localities. The pearl banks in the Gulf of Mannar, both on the Indian and Ceylon sides, are not continuously occupied by pearl oyster deposits; their occurrence is irregular and roughly cyclic, short series of productive years alternating with longer series of blank years when the beds are either very poorly stocked or absolutely barren. These banks appear to be repopulated at intervals by spat from the permanent or mother beds in Palk Bay. When this happens, the resultant beds are often exceedingly extensive, aggregating even as much as a hundred square miles in area in some years. The quantity that comes to maturity is comparatively small, but even then a favourable year may yield anything up to 40 or even 80 millions of oysters during a fishery. To harvest pearls the fishers must wait till the oysters are over three years old, but if they are required for canning purposes they may be fished profitably when two years old. At this age they are very delicate and more tender than when they are a year or more older.

Pinna.

Tamil—*Akku* (ஆக்கு).

In shallow water from half to five fathoms, a large species of Pinna is sometimes found in great abundance. In some places, as for example in the south-west of Palk Bay, they occur so close inshore that bathers run great risk of cutting their feet on the projecting knife-like edges of these shells. The common species is our largest bivalve, running to a length of 13 inches. It is of

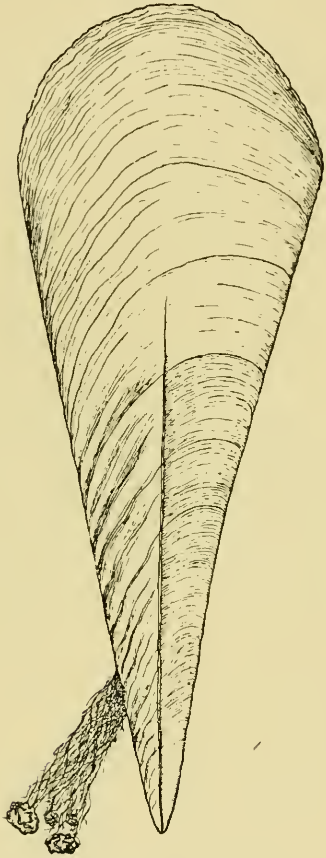

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Fig. 29.—The Common Pinna. × $\frac{1}{3}$.

elongated wedgeform, and lies buried in sand with its apex downwards, showing an inch or two only of the wide ventral margin projecting above the bottom. In the 1905 Ceylon pearl fishery, several millions of pearl oysters were found in one area utilizing the projecting edges of living Pinna shells as foothold.

No one eats Pinna on the Indian coasts, but in China it is in great demand, and in Japan large quantities of the great adductor muscles, circular discs of white flesh measuring 1½ to 1¾ inch in diameter, are cut out and dried for export to China, in the same manner as they treat the foot of Haliotis (the *abalone* of the Californian coast).

RAZOR-SHELLS (SOLENIDAE).

Tamil—*Pul ākku* (புல் ஆக்கு).

In shallow sandy bays, several species of Razor-shell are common but the size is much smaller than the average attained by British species. They are long scabbard-shaped shells living buried upright just beneath the surface. In most countries they are highly esteemed as a tasty marine delicacy, but no one collects them in India, as no demand exists.

ARK-SHELLS OTHER THAN ARCA GRANOSA.

Besides *Arca granosa*, there are two other related forms which though not used at present, are potential sources of food supply.

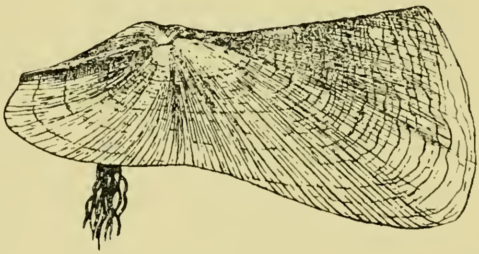

FIG. 30.—The TWISTED ARK-SHELL. (*P. tortum.*) × $\frac{3}{4}$.

They are the hairy ark-shell *(Barbatia barbata)* and the twisted ark-shell, *Parallelopipedum tortum*, so called because whilst the opposite sides are roughly parallel, none of the angles are right angles. Both of these are fairly numerous in certain parts of Palk Bay and were shellfish more widely appreciated by our Indian populations they would find their place in the market supply.

The habitat of both is between the 4½ and 6 fathom lines on a bottom of dirty muddy sand. They do not form continuous beds but occur scattered singly over large areas. Their shells often give foothold to pearl oysters on the banks north-east of Tondi.

The Weaving Mussels (Modiola spp.).

Several medium-sized species of the weaving mussels exist in our seas and in Palk Bay; one is so abundant that I have seen several square miles of sea-bottom covered continuously with a carpet of their shells, felted together in a tangle of byssal threads. The average size is not too small and were there any demand, tons of them could easily be dredged in Palk Bay. The larger ones are excellent eating, while the smaller would make, if dried and pulverized, an excellent manure.

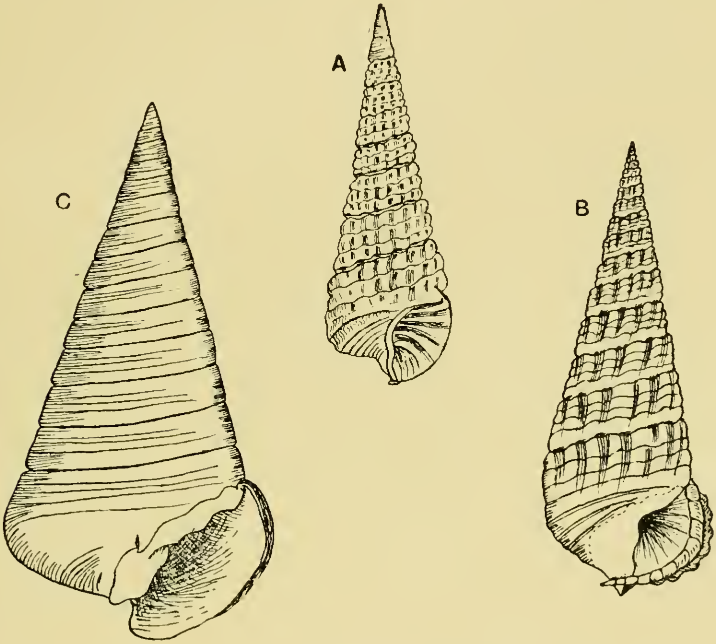

Fig. 31.—Horn shells { A. *Potamides fluviatilis.* × $1\frac{1}{2}$. B. *Potamides palustris.* × $\frac{6}{7}$. C. *Potamides fuscum.* × $\frac{7}{10}$.

Horn Shells (Potamides spp.).

Except for lime-making the great Horn shells, *Potamides (Telescopium) fuscum* and *P. (Pyrazus) palustris*, often to be found in abundance in the mangrove swamps of the Kistna and Gōdāvari deltas, are not utilized for any purpose. Among the Malays both are esteemed as food; they throw them on wood fires, and when they are sufficiently cooked, break off the top of the spire and suck the animal out through the opening.

In the Philippines they are regarded as good food and are frequently sold in the local market. Numerous other related smaller forms (*Cerithium* spp.) are also sold, the price averaging 5 centavos per kilogram, or about 6 to 7 pies per pound (200 centavos =one U.S. Dollar).[1]

THE KNOBBED WHELK (MELONGENA VESPERTILIO Lamk.).

This large whelk-like shell is not uncommon in saltwater lagoons and shallow bays on the east coast, where it attains a length of from 8 to 10 centimetres. Its pretty, regularly knobbed shell, deep chestnut in tint, is often to be seen along the margin of Ennur and Pulicat backwaters, but in many of these cases the actual inhabitant is a hermit crab which has appropriated the shell after the death of the original owner.

Melongena is eaten freely in the Malay Archipelago according to Seale;[2] it is also to be seen exposed for sale in the Suez markets, being common in the canal and neighbouring lagoons.[3]

[Since writing the above I find that the Knobbed-Whelk is caught in considerable numbers along with the common chank (*Turbinēlla pyrum*) in thūri nets off the Tanjore and South Arcot coasts, and that the flesh of both is eaten after boiling by the Pattanavar villagers. Indeed the fisherfolk of these coasts are accustomed to boil and eat the flesh of any large gastropods they may catch in their nets; among others the great Tun-shell (*Dolium*) and the equally large Melon-shell (*Melo indica*) when caught—both are rare—are placed in boiling water, the flesh extracted and eaten, and the empty shells sold to the chank-shell lessee, who sells them as curiosities in Madras and other large towns. The shells of the knobbed-whelk are used in lime-burning to make whitewash lime.]

LAND MOLLUSCS.

For some reason which I have failed to penetrate, land molluscs are not utilized for food except in the single instance of the great king-snail, *Ariophanta basileus*, a denizen of the Cochin teak forests, which is occasionally used by the semi-wild tribes that live on forest produce. With this exception none of the Indian land-snails

[1] Alvin Seale—"Notes on Philippine Edible Molluscs" *Philippine Journal of Science*, Vol. VII, No. 4, p. 279, Manila, 1912.

[2] Alvin Seale, *loc. cit.*, p. 279.

[3] Cambridge Natural History, Vol. "Molluscs", p. 102

are eaten so far as I can learn. This is not due to any lack of species of adequate size, if we take the apple-snail, *Helix pomatia*, so highly esteemed by the ancient Romans and the modern French, as a standard, or the more common English garden snail *(H. aspersa)*, utilized very abundantly by the French when the former species is unobtainable. In Madras gardens two clean-looking snails are found, smaller indeed than *Helix aspersa*, but still large enough for culinary use; one is the single-banded *Ariophanta ligulata*, the other the two-banded *A. biserialis*. Larger than these are several species found in the Anamalai, Palni, Nilgiri and other hill tracts. Among the more notable are the Ariophantas. *A. basileus*, already mentioned as occasionally eaten in the Cochin teak forests, is also found in the Anamalai and Nelliampathi hills; it is a magnificent species often measuring 2½ inches in diameter. *A. maderaspatana*, a smaller species, inhabits the Palni hills, while another, *A. kadapaensis*, fully equal in size to *Helix aspersa*, is found in the Anamalais, together with *Helix ampulla* of about the same dimensions. *A. semirugata* is another fair-sized snail found in the Coimbatore and adjacent districts. Finally from Mysore comes a slightly larger snail, *Cyclophorus nilghericus*. It will be noted that most of these are hill species, found chiefly in the jungle tracts that clothe the lower slopes and creep up sheltered ravines. Taken generally land-snails are not plentiful on the plains, being replaced there by the pond-snails *(Ampullaria* and *Vivipara)* found in abundance wherever paddy cultivation is of importance.

In dry sandy tracts where babul thorns abound, especially in Tinnevelly and Ramnad districts, a small white *Helix* is often exceedingly numerous, but although one would expect this to be of some food importance at least in times of famine, I cannot trace any utilization even in years of direst distress. A *mamul* prejudice prevails against the use of any land-snails.

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